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Editorials

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Messsage of the President

NEW Year's greetings to Association members everywhere. With another year in the offing the time is favorable for pausing at the cross-roads to take stock of accomplishments of the past year and to chart the course for the future.

Another decisive forward step has been taken in broadening our field to include food sanitarians. We start the year under the new name of INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS. Sanitation problems in the two fields are identical and many members, particularly those in city health work, have responsibilities in both fields. A most cordial invitation is extended to other workers interested in food sanitation to join this organization. We know of no other association in this special field. However, with this broadening of activities there is no intention of placing any less emphasis on work in the important field of milk sanitation.

One of the immediate demands for service in the food sanitation field is the enlargement of the work of standardizing the sanitary features of equipment to cover that used in the food field. A committee has been appointed to lay the

foundations for this work. Manufacturers of equipment in at least one of the food fields are looking forward to securing the unifying and stabilizing effects of such committee work.

While your Association has maintained leadership in technical developments it may be neglecting general problems such as that of assisting the membership in establishing its professional status and in maintaining favorable working conditions and a living wage. Consideration is being given to inaugurating committee study of problems in this field.

No association can be any stronger than its membership and its strength is largely dependent upon the amount of effort members are willing to devote to association and committee work. Your continued loyal support of your officers and committees in carrying on the work of the New Year is earnestly solicited.

W. Tiedeman, President

Biological Technology—Not Engineering

WHEN Vannevar Bush addressed the one hundred and seventy-fifth anniversary celebration at Rutgers University on the subject "The Case for the Biological Engineer," he used the development of chemical engineering to make the point that this latter subject did not develop very happily until a new philosophy for chemical engineering was created by the concept of the unit process (1). "The chemical engineer of today is a far different individual from a mere hybrid chemist-mechanical engineer; he has a whole approach and a set of thought processes which are uniquely his. He has avoided being superficial in two subjects (chemistry and mechanical engineering) by creating a third in which he can be decidedly thorough." He applied these ideas to the newer profession which he called "Biological Engineering".

The story in our contemporary *Chemical Engineering* goes on to point out that this new development is due to the "unique technology which, at the professional level, combines the knowledge and skills of microbiologists, clinicians, chemists, physicians, and engineers". Dr. Bush may be correct when he looks forward to the recognition of biological engineering as a professional entity, but this desideratum does not yet seem to be attained. The reason is that we do not have enough information about the biological reactions to warrant such a use of the word "engineering". Just as we pointed out in our discussion of "Food Technology vs. Food Engineering as a Professional Entity" (2), technology is a broader field than that covered by engineering. We are warranted in christening a new professional entity only when our knowledge is sufficient to enable us to compare the given subject with others in the same category. We must say that we are out of sympathy with those who seek to elevate a subject by the legerdemain of words to an intellectual or professional level that has been created in other fields by "blood, sweat, and tears"—yes, literally these, as anyone who has participated knows only too well. We are reminded of the aspirations of "Social Science", "Personnel Engineering", yes even "Christian Science".

Without doubt, there is a professional entity that is potentially involved in this field. We consider its scope broader than just the biotics. We think that foods should be included. The technology of foods involves applied bacteriology,

biophysics, and biochemistry to as great an extent as does that of the biotics. In addition, there is a developing literature in the subject, a number of professional societies, and a good start in the field of special equipment design. The latter is comprised in the work of the Committee on Sanitary Procedure of this Association. This latter bids fair to find application in the general food field.

Already, the University of Wisconsin has announced a formal course in biochemical engineering (3). We hope that this progressive development will be broad enough to embrace the application of engineering to all these products whose technology must rest on bacteriology, biophysics, biochemistry, chemistry, and engineering. More particularly, we hope that research will provide the information covering breadth and depth on which engineering can be predicated in fact as well as in name. So, if there is to be "Biological Engineering" at all now, it should be broad enough to include foods as well as the biotics. J. H. S.

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2. Editorial. Food Technology vs. Food Engineering as a Professional Entity. *Journal of Milk Technology*, May-June 1945, p. 125.
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Epidemics From Contaminated Eating Utensils?

A REPORT has recently appeared in the literature (1) on the probability of an outbreak of gastroenteritis from contaminated eating utensils. As in most cases of food-borne outbreaks, the evidence reported is not clear-cut and convincing enough to incriminate any particular vehicle. However, the above investigation was so carefully conducted that in the absence of positive evidence, the whole setup points to unclean eating utensils. This report is important.

When our attention began to be attracted to the possible etiological function of contaminated food in various outbreaks of disease, say about twenty-five years ago, we had not much better evidence to go on. The reporting of outbreaks, even no more explicit than the above, served to draw attention to this possibility. As a result, many outbreaks have come to light.

Enforcement officials appreciate the value of such reports as the above. They are wonderfully effective to help secure compliance and support. We understand the reluctance of professional people to publish that which lacks scientific conclusiveness. But we also know that progress in food sanitation must go through this stage before a more precise epidemiology can be worked out. The authors did a commendable job. We hope others will be on the lookout also. J. H. S.

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1. Pond, M. Allen, and Hathaway, John S. An Epidemic of Mild Gastroenteritis of Unknown Etiology Presumably Spread by Contaminated Eating Utensils. *American Journal of Public Health*, November 1947, p. 1402.

Dairy Products Improvement Institute

THE first annual meeting of the newly organized Dairy Products Improvement Institute, Inc., was held in New York City on January 16. One hundred guests and members were in attendance. This is a membership corporation set up by a group of dairy plant operators in the eastern states, with Dr. Carl V. Larson of Buffalo as its Managing Director. Its objectives are:

1. To foster the improvement of quality of milk and cream used in processing and manufacturing dairy products;
2. To assist members, producers and others in the attainment of improved quality of milk and cream used in processing and manufacturing dairy products;
3. To promote quality standards for milk and cream, and the movement of milk and cream of equivalent quality between areas within the United States of America as may be of benefit to the dairy industry, and to consumers, and of assistance to government officials, and to collect and disseminate information pertaining thereto;
4. In general, to do all other lawful acts and things incidental or necessary to accomplish the foregoing purposes and to exercise all the powers conferred by law upon such corporations.

The speakers were former New York City Health Commissioner Ernest L. Stebbins, now Director, Johns Hopkins School of Hygiene and Public Health, Baltimore; Dr. Leland C. Spencer, Professor of Marketing, Cornell University; and A. W. Fuchs, Sanitary Engineer Director in Charge of the Milk and Food Section, United States Public Health Service.

W. A. Wentworth, president, stated the new organization's interest is in "an adequate supply of sweet cream of a quality that will assure the protection of public health and will also contribute to a superior quality of dairy foods for consumers." He said "there must be some sound policy which would protect the public health fully and provide an economic cream supply without disturbance of the total milk supply of the Eastern States nor the income of milk producers in this area."

Dr. Stebbins warned of dangers involved in political and economic pressures in the health phases of milk control.

He said: "Utilization of Health Department regulations to regulate milk distribution opens the health authority to pressures, political and economic, which would not necessarily be in the best interests of the public health. The present movement towards uniform standards and regulations, carried to its logical conclusion for the establishment of uniform regulations for the production, processing, and distribution of milk and milk products throughout the United States, would go far to remove the dangers of political and economic pressure in the strictly public health aspects of milk control."

In the opinion of Mr. Fuchs, "the insistence of cities and states on their own regulations and inspection by their own officials reaches rather absurd limits in areas where the production is normally carried on for more than one market."

Mr. Fuchs said that dairy industry members supplying different markets are confronted with a real problem arising from the multiplicity of laws and regulations in the states and cities, often being "subjected to unnecessary inconveniences

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Current Investigations of Laboratory Methods Used in Milk and Food Utensil Sanitation*

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INTRODUCTION

DURING the recent war years it was possible for the U. S. Public Health Service to undertake only limited laboratory investigations pertaining to milk or food sanitation. In general this was dictated by the necessity of solving immediate problems of equipment or procedure posed by the mobile laboratories operating at that time in war areas in various parts of the United States. In this connection we were directly concerned with the application of Standard Methods in the bacteriological analysis of milk, water, and swabs from food utensils. Where modifications seemed warranted, recommendations have been made to the respective American Public Health Association committees on Standard Methods, and many such items have been incorporated in the current procedures. The background, as well as the supporting evidence, for some of the requirements retained and the modifications proposed, may not be generally known as is indicated by frequent inquiries received. Accordingly it seemed appropriate to review some of our recent and current investigations of laboratory methods that may be of interest to milk and food sanitarians.

AGAR PLATE COUNTS

Media. Compartive tests have been made of various ingredients for plating agar, in the interest of eliminating milk from the present standard medium, due to difficulties sometimes encountered with precipitates and turbidity. This is desirable, provided a suitable medium is selected which, without milk, will yield counts approximating those obtained with the present standard medium containing milk. While information on which to take action has not yet been secured, our investigations indicate the possibility of achieving a satisfactory medium, although this may be delayed pending investigation of nutritive requirements of certain milk bacteria. Ultimately this information may have a bearing on the materially higher counts obtained by a slight lowering of incubation temperature. Improvement in these factors concerned in the agar plate method is considered fundamental in correlation with other bacteriological and biochemical methods or with existent sanitary conditions.

Studies have been made in comparisons of various peptones, extracts, and other modifications of plating media, from the standpoint of obtaining more precise and uniform enumeration of the bacteria present in milk. Some 50 different modifications of media were used in comparing the better peptones generally available for bacteriological use, the effect of addition of certain other ingredients reported to influence counts, or variation in amounts of ingredients.

Time does not permit an analysis of the results obtained, but examination of the records indicates the following

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trends. While some media were considerably inferior to the present standard tryptone-glucose-beef-extract agar containing milk, the better peptones gave comparable results. With some milk samples counts were materially higher with media containing milk, in extreme instances up to 1000 percent or more.

A clearer media, permitting greater contrast with colonies, is desirable so that the smallest colonies may manifest themselves more readily, inasmuch as overlooking these colonies seemed to be the chief cause of the largest discrepancies observed. Better nutritive properties in plating media may likewise increase the size of such colonies so they may be visible readily.

Careful study, however, should be given before general acceptance of any modified medium that may be proposed. As an example, a comparison was undertaken of a sample of an experimental dehydrated medium submitted to us as a substitute for the standard tryptone-glucose-extract-milk agar. In some instances the proposed medium yielded equivalent counts, but with other milk samples only half as many colonies appeared as on the standard agar containing milk.

Incubation Temperature. We have made several comparisons of the effect of the alternative incubation temperature of 32° C. compared to 37° C., in many instances using media without milk as well as the standard agar containing milk. Differences due to media generally were slight compared to the larger numbers of colonies that developed following incubation at 32° C. compared to 37° C. Frequently samples of pasteurized milk showed 2, 3, or 4 times and in some instances 10, 20, or 30 times as many colonies as 32° C. This tendency was more pronounced for samples of pasteurized cream.

The present (8th) edition of *Standard Methods for the Examination of Dairy Products* permits incubation at either 37° C. or 32° C. For some years it has been recognized that incubation at the higher temperature is unsuitable in that it is above the optimum for the bacteria ordinarily present in milk, and that incubation at 32° C. is definitely advantageous. The current trend in public health laboratories is for incubation of pathogens at 35° C. instead of 37° C. The present edition of *Standard Methods of Water Analysis* accepts 35°–37° C. as the standard incubation temperature for agar plate counts and coliform tests. The A.P.H.A. Standard Methods Committee for Dairy Products determined by means of questionnaires that incubation of milk plates at 35° C. was acceptable to most directors of state and city laboratories, although there was a demand that 32° C. be used by those who understood the advantages of incubating milk plates at that temperature. Hence both 32° C. and 35° C. are the standard temperatures of incubation stipulated in the 9th edition of Standard Methods.[1]

Thomas, Levine, and Black[2] recently reported on several series of milk samples, subjected at different seasons of the year to each of the alternative bacteriological tests for sanitary quality, using the procedures to be required in the next (9th) edition of *Standard Methods for the Examination of Dairy Products.*

Table 1, taken from that report, presents a tabulation of plate counts and direct counts of raw milk to be pasteurized at one season of the year, grouped according to reduction times by the methylene blue test. This illustrates the general relationship of plate counts at the three incubation temperatures, both to each other, and in relation to microscopic clump counts, as well as reduction times. By classifying the counts according to reduction times, the table presents a wide range of comparative counts, from low to extremely high. It is apparent that there is a greater difference between

TABLE 1

AVERAGE PLATE COUNTS OF RAW-TO-PLANT MILK AND MICROSCOPIC CLUMP COUNTS, GROUPED BY METHYLENE BLUE REDUCTION TIME

Reduction hours	*Plate count* 37° C.	35° C.	32° C.	*Microscopic count*
1	28,000,000	36,000,000	25,000,000	7,400,000
2	4,700,000	5,200,000	5,600,000	4,300,000
3	1,800,000	2,100,000	2,300,000	2,500,000
4	940,000	1,700,000	1,500,000	1,500,000
5	480,000	670,000	690,000	1,100,000
6	130,000	220,000	230,000	400,000
7	99,000	190,000	190,000	270,000
8	160,000	280,000	290,000	510,000
9	24,000	47,000	53,000	300,000

counts obtained at 37° and 35° C., than between those at 35° and 32° C. Usually the plate count at 35° C. is only slightly lower than the 32° C. count.

REDUCTION TESTS

Methylene Blue. Several hundred samples of raw milk to be pasteurized were examined in 1944 using plate counts, clump counts, and three reductase tests, including the standard methods procedure, a modified test in which the tubes were inverted hourly, and a series in which the tubes were iced before examination. The modified reductase test in which the tubes were inverted hourly, as will be required in the next edition of Standard Methods, gave much better correlation with the bacterial plate counts and microscopic counts than did the reductase procedure then standard. Similar results were reported by Abele[3] in 1945, and Thomas, Levine, and Black[2] recently reported comparable results on milk samples subjected at different seasons of the year to the procedure to be required in the next edition of Standard Methods.

Table 2 summarizes the results by the methylene blue reduction test, reported by Thomas, Levine, and Black, showing the percentage of samples in each reduction group that fell in one of three grade groups, based on plate counts at 37°, 35°, or 32° C., and on the direct microscopic clump count. It

TABLE 2

PERCENTAGE OF RAW-TO-PLANT MILK FALLING INTO PLATE AND MICROSCOPIC CLUMP COUNT GROUPS, CLASSIFIED BY METHYLENE BLUE REDUCTION

Reduction hours	*Samples total*	*Count under 200,000* Plate count 37°	35°	32°	Clump count	*210,000–1,000,000* Plate count 37°	35°	32°	Clump count	*Over 1,000,000* Plate count 37°	35°	32°	Clump count
½	4	0	0	0	0	0	0	0	0	100	100	100	100
1	15	0	0	0	0	0	0	0	0	100	100	100	100
2	47	0	0	0	0	6	6	6	2	94	94	94	98
3	51	8	6	6	0	33	22	22	29	59	73	73	71
4	56	34	25	25	9	45	38	38	52	21	38	38	39
5	47	68	47	45	19	23	43	38	49	9	11	17	32
6	48	81	73	71	23	17	25	25	73	2	2	4	4
7	33	88	85	82	48	12	12	15	45	0	3	3	6
8	25	92	84	76	44	8	12	20	52	0	4	4	4
9	12	92	83	92	50	8	8	0	42	0	8	8	8

will be noted that when the direct clump count is considered, only 50 percent of the samples were in the low count group, even by the 9-hour reduction period.

Resazurin. An alternative reduction test using resazurin has been included in the 9th edition of Standard Methods, and equivalent values for this procedure are still to be established. Two methods of reading the test are included, the "one hour" and the "triple-reading" test. In work reported by Thomas, Levine, and Black,[2] both tests were followed but only the "triple-reading" test results were reported. The endpoint in this test is reduction beyond a certain color standard (P 7/4 according to the Munsell system). Samples were examined at hourly intervals and inverted after each reading. A record was made of the stage of reduction of all samples at each hour, but only the end point reduction beyond P 7/4 was used.

Table 3 summarizes the results by the resazurin reduction tests reported by Thomas, Levine, and Black, showing the percentage of samples in each reduction group that appear in one of three grade groups, based on plate counts at 37°, 35°, or 32° C., and on the direct microscopic clump count. All samples not reduced in 3 hours were recorded as reduced in 4 hours for the purpose of this paper, but complete records were kept up to 8 hours.

From table 3 it may be seen that most of the samples reducing in one hour fell into the higher plate count group (over 1,000,000). However, some samples that reduced in one hour appeared in the lower plate count group. A further microscopic study of these samples showed that they contained a large number of leucocytes. It has been reported [4] that leucocytes have a quick reducer effect on resazurin. The leucocyte content of these particular samples varied from 2 to 23 million per milliliter, and the methylene blue reduction time varied from 4 to 9 hours. On the basis of the direct microscopic clump count, only 41 percent of the samples were in the low count group, even after 4 hours.

MICROSCOPIC COUNTS

Studies on modifications of the direct microscopic examination of milk advocated by various individuals indicate wide variations in the results possible by this technique, and the desirability of remedying this situation. In addition to sampling error, there are various points in the preparation of the smear, in the nature and reaction of the stain, in the nature and amount of light source, as well as in the mechanism of examination, that influence results materially.

In preliminary microscopic examinations of raw and of pasteurized milk, under some circumstances use of a color filter resulted in observation of bacterial cells not discernible by

TABLE 3

PERCENTAGE OF RAW-TO-PLANT MILK FALLING INTO PLATE AND MICROSCOPIC CLUMP COUNT GROUPS, CLASSIFIED BY RESAZURIN REDUCTION

Reduction hours	Samples total	Count under 200,000				210,000–1,000,000				Over 1,000,000			
		Plate count			Clump count	Plate count			Clump count	Plate count			Clump count
		37°	35°	32°		37°	35°	32°		37°	35°	32°	
1	72	4	4	4	1	6	4	4	7	90	92	92	92
2	104	23	15	15	8	39	33	34	37	38	51	54	56
3	80	65	55	53	19	28	33	35	63	8	13	13	19
4	83	94	84	82	41	5	13	14	52	1	2	4	7

Standard Methods procedure. A series of several pasteurized milks and creams examined, using 4 staining procedures, resulted in higher microscopic counts in some samples compared to plate counts at 32° and 37° C., but in other samples microscopic counts were lower than plate counts on corresponding samples.

During the past year Dr. B. S. Levine of our laboratory has made a special study of the microscopic clump count, including stains, procedures, methods of examination, and comparative counts. He has developed a stain which in a recent series of samples, in many instances yielded twice the number of clumps observed by Standard Methods procedures. The detailed results will be made available in a separate paper.

COLIFORM MEDIA

During the past few years there has been an increased emphasis on examination for coliform organisms in pasteurized milk as an indicator of post-pasteurization contamination. In 1944 a sample was received of a revised formula for one of the direct plating media now listed in Standard Methods for presumptive tests for organisms of the comform group. Arrangements were made to obtain a seres of commercially pasteurized milk samples for use in a comparative study of the various media allowed by Standard Methods. In this investigation three tubes of each of three dilutions of alternative liquid media were used, together with single plates with 1 ml. portions of both alternative solid media allowed by Standard Methods, as well as standard plate counts at both 37° and 32° C.

Later three additional liquid media were compared, namely, desoxycholate lactose broth, EC media, and lauryl sulfate tryptose broth. Additional information obtained on the same samples included plate counts at 37° and at 32° C., together with preparations for direct microscopic examinations.

Inspection of the results showed good agreement among the various liquid and solid media, although fluctuations occurred. None of the newer liquid media appeared superior to those already in Standard Methods. Additional milk samples were examined and observation of the results obtained, together with those of former experiments, indicated that a solid plating media yielded the most quantitative information.

PHOSPHATASE TEST

In 1943 we received a copy of a new technique on the phosphatase test proposed by Scharer.[5] This test made use of the catalytic effect of copper on the formation of the indophenol blue color, and was reported to effect a more rapid and complete precipitation of protein, yielding about twice the color gain per unit of enzyme as obtained on the present laboratory technique, with the color formation being complete in about two minutes. It was also a simpler procedure inasmuch as it omitted the boiling and cooling steps now required and used a simplified buffer.

This technique will be included in the next edition of Standard Methods in the last chapter concerned with "Screening Tests," since the method has not been published and hence has not been considered by the Association of Official Agricultural Chemists. We have had considerable experience with this technique and can confirm the advantages reported. It was believed that inclusion of this procedure in the next edition of Standard Methods would allow a larger number of laboratories to utilize it, and determine if it appears generally satisfactory.

SWAB COUNTS

There has been widespread interest and activity in food sanitation during the past few years. In connection with

the bacteriological examination of eating utensils made by the various mobile laboratories operated during the recent war by the U. S. Public Health Service, it was found necessary to improve and standardize the equipment and procedure used.

An investigation was made of the types of containers used in connection with these food utensil examinations and their suitability, and steps were taken to determine the availability of satisfactory containers. Screw cap vials with well caps were ordered for use as swab containers, and these were distributed to each of the trailer laboratory units engaged in the bacteriological examination of food utensils.

A report was soon received that upon sterilization, some of plastic caps deteriorated, accompanied by the odor of formaldehyde. The stock of caps on hand was sorted out, and about 10 percent appeared to be of different composition, these seeming to be the caps that decomposed upon steam sterilization.

Arrangements were made with the Chemical Laboratory of the U. S. Public Health Service in Cincinnati for testing various lots of plastic caps for formaldehyde and phenol. Information concerning our experience with the caps was forwarded to the research laboratories of two of the large manufacturers whose caps were on hand, and their advice requested.

We also recorded the pH changes that occurred with various lots of plastic caps upon repeated sterilization. It appeared that the caps on hand surviving preliminary steam sterilization without appreciable change still gave off sufficient alkaline products to change the pH of the standard buffered phosphate diluent. With the stock of caps on hand this change was so slight that it seemed feasible to utilize these caps. It was found that increasing the concentration of the diluted phosphate buffer tendfold was a satisfactory way to compensate for the variations in plastic caps.

A comprehensive comparison of various types of plastic caps was made, including several types of experimental caps submitted by manufacturers, using both regular and 10 strength buffered phosphate, with and without applicators. It was soon ascertained that the wooden applicators gave off acid products upon steam sterilization while partially submerged in the dilution water. With plastic caps that gave off alkaline products, these acid and alkaline substances might neutralize each other and the final diluent be near the proper pH even with the regular phosphate buffer content. With the better mineral-filled plastic caps which did not yield alkaline products, it was found essential to use a more concentrated buffer (10 times that ordinarily recommended) in order to have the final pH of a sterilized swab vial outfit within the desired neutral range.

An order was placed for plastic well caps to be made of the mineral-filled plastic tested and found satisfactory for use in the bacteriological examination of food utensils. Upon receipt of these caps, tests were made. The results showed no similarity to the experimental caps of that material previously submitted by the two largest manufacturers. On the contrary, the caps reacted in a manner identical with the ordinary wood-filled plastic caps already available. This matter was taken up with the supply house, the supply house submitted representative caps to the manufacturers, and we were later advised that the manufacturer tested the sample caps submitted and admitted that the caps were made of the wrong material, and were making a replacement shipment.

Samples of the replacement shipment of caps were tested for suitability for use as closures in the bacteriological examination of food utensils, by deter-

minations of changes in pH of buffered phosphate diluent following steam sterilization on vials closed with these caps. Upon repeated daily testing of these, subsequent to autoclaving, they were found to be suitable closures.

These details have been supplied so that those affected by the unavailability of suitable plastics during the war may understand some of the factors responsible, and why we have recommended the use of a tenfold stronger buffered phosphate dilution water for restaurant utensil swab samples. This 10X buffered phosphate complies with the present A.P.H.A. "Technic for the Bacteriological Examination of Food Utensils" under the last statement on "Laboratory Procedures" that "Laboratories not conforming fully with this procedure should have comparative evidence to show that the variations used give comparable results."

One of the supply houses has developed longer vials designed to take a standard 3" cotton-tipped applicator without the necessity of cutting off about ⅜" as was heretofore necessary with the standard 21 x 70 mm. vials. The new vials now available are approximately 21 x 79 mm. and have been found convenient.

STORAGE OF SAMPLES

In 1944 studies were made of the effect of variations in storage of restaurant swab samples upon the plate counts per utensil surface examined. Observation of the data revealed a tendency to maintenance of approximately the same bacterial count durstorage of 6 to 12 and even 24 hours duration, using 10X buffered phosphate diluent with samples refrigerated. Only in some instances where the original count was near the border line of the standard of 100 organisms per utensil surface, would the interpretation of the results have been different if the swab samples had been analyzed at 12 or even 24 hours after collection.

It is still considered desirable to plate the dilution water samples as soon as possible, preferably within 4 hours of swabbing, but where this cannot be done, samples should be properly refrigerated and analyzed within 24 hours of swabbing.

INHIBITORS FOR QUATERNARY AMMONIUM COMPOUNDS

In connection with testing utensils in which quaternary ammonium and similar compounds have been used as bactericidal agents, it was considered desirable to study neutralizing agents for the purpose of inactivating the cationic germicides at the time swab samples are taken.

Experiments were undertaken to determine the neutralizing power of an inactivator recommended for this purpose. This was to be used where a residual amount of bactericide might be transferred to the sample vial by swabbing, using the swab-rinse plate count method for the bacteriological examination of eating utensils. This inactivator was checked by procedures comparable to field conditions of swabbing and subsequent handling of the sample. Eating utensil samples obtained from forty-seven restaurants or taverns were used as the source of the pooled or individual swabbings which were tested with various concentrations of bactericide, with and without inactivator. Bacteriological examinations were made immediately, and after 1, and in most instances, 4 and 24 hours storage under refrigeration. The majority of the plates were counted under a wide field binocular microscope to insure against overlooking any organisms surviving.

Although it was found that the inactivator itself was not bactericidal in the concentration recommended for use, it did not always neutralize the germicide under the conditions stipulated, or under the practical field conditions studied.

Further laboratory studies of inhibitors for this purpose were reported recently by Weber and Black.[6] In this work a gross screening procedure was first used to evaluate various compounds. Phosphate buffer, culture (*Escherichia coli*), and inhibitor were mixed in a Petri dish, allowed to act for 10 minutes, following which germicide was added. Ten minutes later the Petri dish was poured with concentrated agar known to arrest germicidal action. Each compound exhibiting satisfactory inhibitory action was further investigated by placing in a test tube appropriate amounts of phosphate buffer, culture, and germicide, followed by periodic plating. After a definite killing curve was established for each germicide, experiments were repeated introducing adequate amounts of inhibitors into the germicidal solution after 2½ and 5 minutes exposure.

Table 4 shows such an interruption of killing curves upon the addition of certain inhibitors, as reported by Weber and Black. Generally speaking, a ratio of at least 10 : 1 and not greater than about 20 : 1 of inhibitor to germicide was required for effective immediate inhibition of germicidal action.

Certain compounds inhibited the germicidal action of quaternary ammonium compounds against *Escherichia coli* after this test organism had been exposed to the germicide for varying periods of time up to at least three hours at room temperature, which was the maximum period studied. Although lecithin was a satisfactory inhibitor in the crude edible grade used, it apparently had a stimulating action on growth of the test organism after a lag period of not less than about 4 hours at room temperature, but at refrigeration temperature (5° C.) there was no increase in the number of bacteria after 24 hours. It would appear that lecithin or certain other inhibitors may be employed satisfactorily in the buffered dilution swab-rinse water for food utensils which have been sanitized in quaternary ammonium germicides.

TABLE 4

EFFECT OF INHIBITORS ADDED TO ALKENYL DIMETHYL ETHYL AMMONIUM BROMIDE (3 PPM)

Results expressed in percentages of *Escherichia coli* surviving

Exposure	*Experiments at room temperature (24–26° C.) pH 7.2*			
(Minutes)	*#242*	*#237*	*#238*	*#241*
0	100	100	100	100
1	72	74	73	74
2	33	50	68	53
2–½		Lecithin *	Naphuride Sodium *	Triton X500 *
3	2	60	67	24
10	0.0	60	63	22
60	0.0	62	60	17
300	0.0**	58	52	15
(Hours)	Lecithin			
24 (5° C.)		61	54	16
72 (24–26° C.)	0.0			

* Added 60 ppm. ** Added 500 ppm.

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A Laboratory and Field Trial Study of Farm Milk Filter Aids*

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MILK filter aids for use on the farm usually consist of various modifications of woven cotton flannels with light to medium napped surfaces and of unwoven cotton discs or pads with or without protective facings. The facings consist of double gauze or of single gauze or of double chemically fixed reinforcements. Double facings mean that reinforcements are applied to each side of the disc. The chemical treatment is confined largely to fixing the fibers at the surface of the pad. When gauze facings are used, they usually consist of coarsely woven (20x12) mesh material.

The physical cleanliness of milk as delivered by farmers at receiving plants and of milk as delivered by retailers to consumers has customarily been determined by passing one pint of milk through a 1¼ inch cotton disc.(1) In contrast with such determinations, the present study is directed at correlating the efficiency of the filter aid as used by the farmer with the amount of insoluble material (dirt or sediment) observed on the 1¼ inch disc, using in the latter case the off-bottom method (1) of determining the amount of sediment in the 40-quart can of milk.

Although organized studies have been made to determine the use of commercial filters and clarifiers to be used in milk plants, relatively few have been made to determine the effectiveness of filter aids to be used by farmers. In 1930, Dahlberg (2) discussed the "Straining of Milk on the Farm," with reference to (1) "the problem of single-service strainers" (filter aids), (2) "metal equipment for strainers," (3) "single-service cloth and cotton," (4) "temperature and fat content of milk affect straining," and (5) "wire gauze strainer." In 1934 Dahlberg and Durham (3) reported on the relation between "The Temperature of Milk Immediately After Milking and Strainer Capacity." Weckel (4) in 1942 called attention to some of the mechanical factors such as different types of discs, and different styles of metal strainers, particularly their misuse, and some of the biological and physical properties of the milk as they influence the straining. Recently in 1945 and again in 1947, Bryant (5, 6) has emphasized the efficiency of cotton discs for the removal of sediment. In a series of short articles, he has described several of the sources of sediment, some of which, because the sediment enters subsequent to initial straining, may often be overlooked by the less well informed dairy service workers and inspectors. Marquardt (7) in 1946 demonstrated the importance of producing milk relatively free from sediment and the relation of the amount of sediment to the flavor of the milk, with particular emphasis on the time interval between its addition and its removal.

PRELIMINARY CONSIDERATIONS

Naturally the keeping of all foreign matter possible out of the milk should be emphasized first. Where efforts have failed to keep it out originally, then it is necessary to provide means to remove as much as possible of the

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insoluble dirt before the milk is delivered at the receiving plant. Customarily the removal is done by degrees using filtering materials, first by the farmer and later by the plant operator.

Some salesmen of filter aids, on the one hand, like to display before the farmer just how much dirt their filters will remove from the milk. When demonstrations are made, as at contests or exhibitions, such removal is not always determined on the basis of a uniform charge of sediment in the milk and sometimes the filtered milk is not tested afterwards to determine the degree to which the sediment actually has been removed. Unless the initial filtration step is followed by a second one, using a filter aid known to remove the dirt effectively, such a display, which shows the removal either of a small or of a large amount of dirt may often be misleading.

On the other hand, when a farmer purposely lifts the assembled strainer, because the milk is flowing slowly through it, to drop it through a distance of 5 to 10 inches into the neck of the can, the filter in such cases should not be blamed in case the sediment test on the milk is unsatisfactory. Bumping and jamming the strainer is apt to cause irregularities in the alignment of parts so that some milk will bypass the filter. Some farmers may even stir the milk with a wooden stick to hasten its flow through the filter. Regardless of speed, the chief objective should be the delivery of milk with the minimum of sediment in it.

Furthermore, when single service cotton flannel squares are laundered with the intention of reuse when dry the flannel usually with its nap almost completely matted down, should not be blamed in case the sediment test on the milk is unsatisfactory. Also, when sediment accidently enters subsequent to the initial straining of the milk on the farm, the filter aid should not be blamed for the failure to remove such sediment.

The type of metal strainer used to hold the filter aid and in particular its construction to assure that all of the milk in the strainer passes uniformly through the flannel or pad also has a direct and important bearing upon its effectiveness for the removal from the milk of insoluble foreign matter.

PROCEDURE

Determinations have been made in the field using a special sediment mixture, hereinafter referred to as the standard mixture. The ingredients to be used in the mixture are oven dried (98-100°C.) separately and then mixed in proportions by weight as follows:

Items	*Percent*
Cow manure, 40 mesh	53
Cow manure, 20 mesh, retained on 40 mesh	2
Garden soil, 40 mesh	27
Charcoal, 40 mesh	14
Charcoal, 20 mesh, retained on 40 mesh	4

In special cases a modified mixture of the following composition was substituted for the standard mixture described above.

The results of tests using the modi-

Items	*Percent*
Cow manure, 60 mesh	26.5
Cow manure, 40 mesh, retained on 60 mesh	26.5
Cow manure, 20 mesh, retained on 40 mesh	2.0
Garden soil, 60 mesh	13.5
Garden soil, 40 mesh, retained on 60 mesh	13.5
Charcoal, 60 mesh	7.0
Charcoal, 40 mesh, retained on 60 mesh	7.0
Charcoal, 20 mesh, retained on 40 mesh	4.0

fied mixture were not comparable with those using the standard mixture. The use of the modified mixture did demonstrate that a foreign pigment often would be imparted as a "smudge" or stain on filter aids somewhat comparable to that imparted by milk from cows which are badly "plastered" with a muck type soil at milking time.

Special photographic standards (1) of the 1¼ inch cotton discs using the following amounts of the standard mixture: 0.0, 0.2, 0.5, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 12.0, and 14.0 mg., have been prepared according to directions in *Standard Methods for the Examination of Dairy Products,* 9th Ed., published by the American Public Health Association, 1790 Broadway, New York 19, N. Y. From the entire range, the practice has been to select certain limits (at 3, 4, or 5 intervals) and to use numerical designations, similar to those in Table 1, to indicate varying degrees of contamination with sediment. The table, based upon standards referred to by Clark,(8) also provides an arbitrary

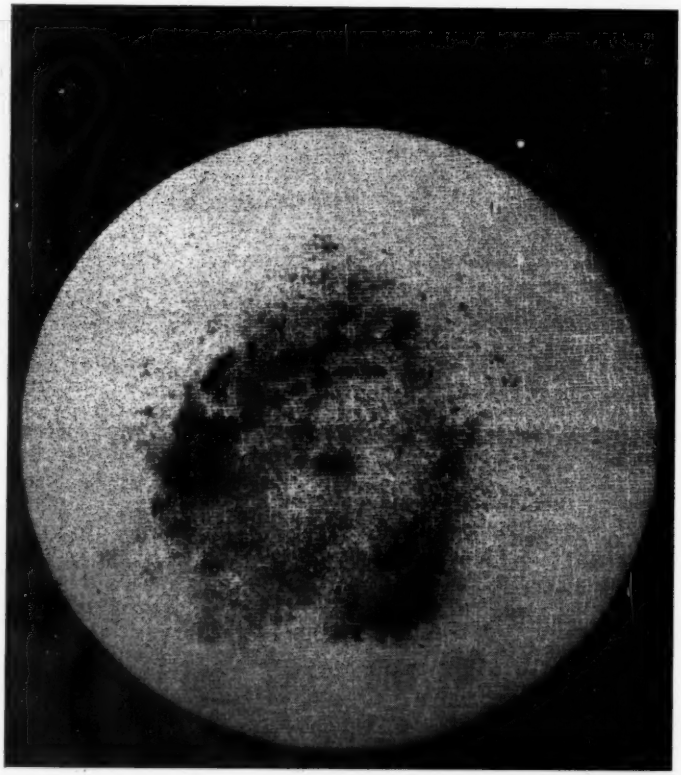

FIGURE 1

Standard sediment charge of 207 mg. on an 8 in. double gauze faced cotton disc.

TABLE 1

Practical designation	*Amount of sediment on 1¼ in. pad mg.*	*Equivalent amount of sediment on filter aid mg.*	*Interpretations of test*
1.....	0.0	0.0	Acceptable or satisfactory
2.....	0.5	11.5	Acceptable or satisfactory
3.....	3.0	69.0	Doubtful acceptability
4.....	6.0	138.0	Unsatisfactory
5.....	12.0	276.0	Very unsatisfactory

interpretation of the degree of contamination corresponding to each numerical designation.

In order to correlate the amount of the standard sediment mixture which would be retained on the filter aids used by farmers with that on the 1¼ inch sediment pads as described above, a quantity of the sediment mixture, selected in proportion to the relative size of the respective surface areas (ratio 1:23), was used to determine by

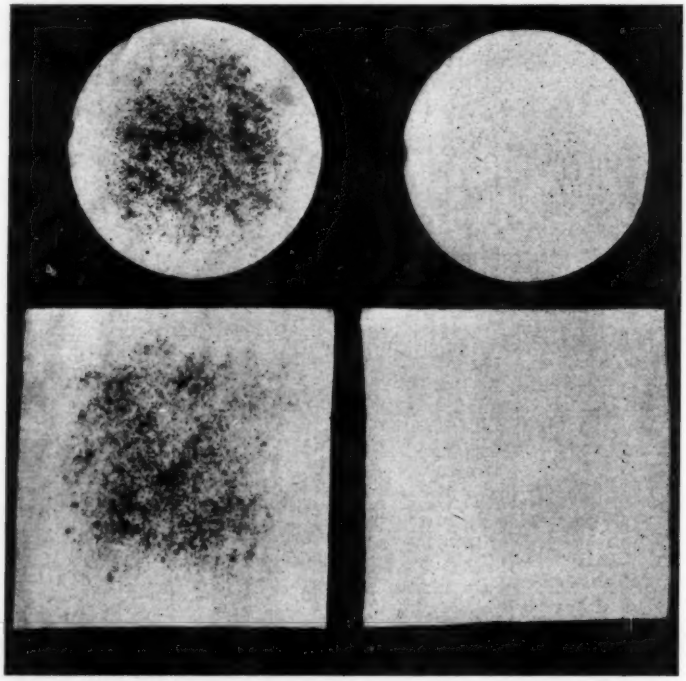

FIGURE 2

Flannels and discs showing standard sediment charge with corresponding expected appearance of filter aid used for restraining the milk when the filter aid subjected to testing has been proven to be Satisfactory. At left is a 7 in. flannel and a 6.5 in. disc. with 207 mg. of sediment on each. At right is a 7 in. flannel and a 6.5 in. disc showing the amount of sediment removed from the can of milk after restraining.

means of actual field tests the relative effectiveness of the filter aids. Invariably a test charge, consisting of 207.0 mg. of the sediment mixture (the average of 138 and 276 mg., see above table), would produce a filter aid approximately midway between the designations 4 and 5, to which was assigned the practical designation "4-5", see Fig. 1. This amount of charge was selected arbitrarily as a basis for determining the efficiency of all filter aids.

To determine the degree to which the filter aid under test removed the test charge of the sediment mixture, a second filter aid of known efficiency for the removal of the test charge was supported in a strainer a short distance below the filter aid which was being tested, see Fig. 2. Observations on the second aid were interpreted by comparison with the quantity of sediment corresponding to the practical designations ranging from 1 to 4. Admittedly, some sediment becomes less visibly apparent by progressively

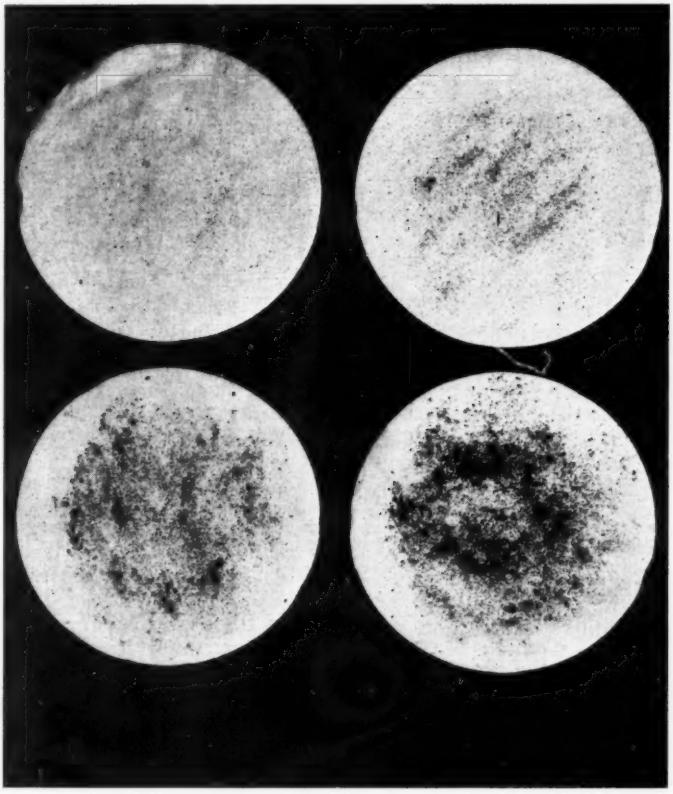

FIGURE 3

Sediment standards on cotton discs. Upper left contains 11.5 mg. of sediment and is rated as Satisfactory. Upper right contains 69.0 mg. of sediment and is rated Fair. Lower left contains 138 mg. and lower right 276 mg. of sediment and both are rated Unsatisfactory.

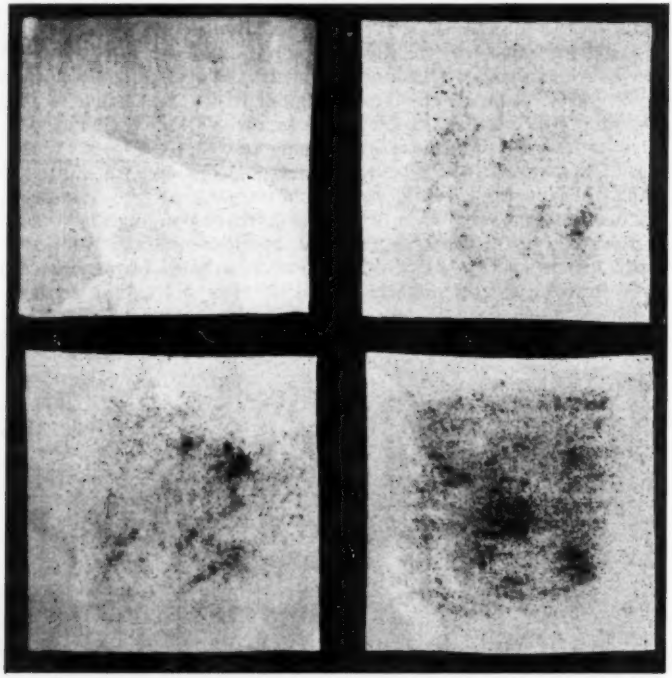

FIGURE 4

Sediment standards on flannel squares. Upper left contains 11.5 mg. of sediment and is rated as Satisfactory. Upper right contains 69.0 mg. of sediment and is rated as Fair. Lower left contains 138 mg. and lower right 276 mg. of sediment and both are rated as Unsatisfactory.

deeper penetration of the filter surfaces, but the results of the test are reasonably comparable and afford a practical means to interpret the relative efficiency of the filter aids.

To prepare the filter aid standards for comparisons, the amount of the standard mixture used for each is listed in the preceding table. Appropriate amounts of the sediment were uniformly distributed over the respective standard discs and flannels prior to mounting. Reducing a 4-5 designation (supplied by using a test charge of 207.0 mg. of the mixture) to a 1-2 designation was interpreted as Satisfactory (S), to a 2-3 designation as Fair (F) and to a 3 or higher designation as Poor (P), see Figs. 3 and 4. Since photographs of the prepared standards are generally unsatisfactory for comparison with unknowns, the use of prepared standards is essential.

Field tests, frequently referred to as the dome test, were made by placing the test charge on the metal dome in the strainer which prevents the milk from being poured directly upon the filter aid. Under the conditions of the tests, this procedure was considered better than adding the test charge to 40 quarts of milk in a can, mixing the

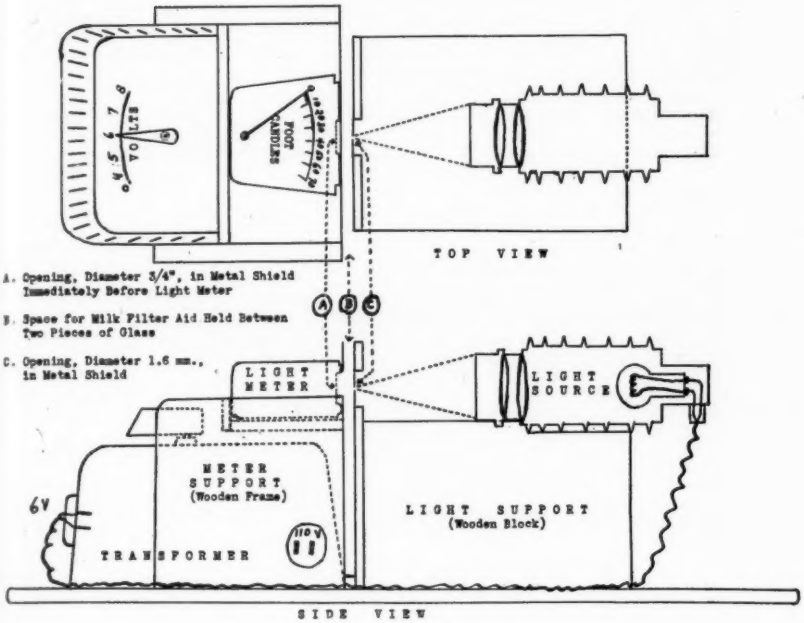

FIGURE 5—Light porosity meter for milk filter aids.

charge with the milk and then pouring the contaminated mixture through the filter aid. In the latter case no one could consistently assure the complete transfer of the test charge from the 40-quart can to the strainer.

As the investigation progressed, it was discovered that field tests could be made with water heated to about 95°F. instead of milk at about 95°F. When the results of tests are compared, this modification eliminates any irregularity which might be caused by milks with varying compositions.

The laboratory observations consist of determining the light porosity of each filter aid in terms of foot candles of light which were registered on a Model DW 58 G. E. Light Exposure Meter, (General Electric Co., Schenectady, N. Y.) Light rays from a constant source were focused on the light meter through a 1.6 mm. orifice, immediately before passing through the filter aid. A No. 353 Spencer Universal Lamp (American Optical Co., Buffalo 15, N. Y.), equipped with a focusable lens and an adjustable transformer, was placed in a horizontal cradle so that the front of the lens in the lamp was centered 75.5 mm. from the 1.6 mm. orifice in the vertical shield in front of the light meter, Fig. 5.

In order that light porosity measurements made with other instruments may be more nearly duplicated, it is essential that such instruments be assembled so that the distances from light source to meter conform to those listed below:

Face of lens to 1.6 mm. hole	75.5 mm.
Face of light meter to 1.6 mm. hole	9.0 mm.
Front of filament in bulb to 1.6 mm. hole	121.0 mm.
Thickness of metal shield	0.5 mm.
Successive spacing of light meter to 1.6 mm. hole	
Face of meter to shield	2.0 mm.
Shield thickness	0.5 mm.
Glass	2.3 mm.
Filter aid	1.0–1.4 mm.
Glass	2.3 mm.
Clearance	0.5–0.9 mm.

To standardize the conditions of use, the light was focused and the transformer adjusted so that the light after passage through the orifice and through the 2 panes of glass, hereinafter referred to, caused the light meter to register 40 foot candles. (The selection of this value serves only as a relative measure of the light porosity of the filters. Some light meters may possess different properties and may be less well suited for this purpose than others. Some observations indicate that a reference material may be used satisfactorily.) When filter aids were interposed between the orifice and the meter, the registration was less than 40 foot candles.

When comparative determinations were made, each filter aid was pressed firmly between two pieces of window glass, not less than 8 inches square, before insertion in front of the meter. Approximately 120 observations have been made on each aid. Preliminary recordings consisted of noting the minimum and the maximum readings among about 40 observations across one side of the filter, then among about 40 observations across the filter at right angles to the first series and finally among about 40 observations on a third side of the filter. The mean of the 6 values was recorded as the average light porosity for the filter. The range from the minimum to the maximum reading on any filter seldom exceeded 5 foot candles.

Obviously the maximum readings are indicative of holes in what may otherwise appear visually to be reasonably uniform filter aids. Furthermore, when such holes are common, proportionately more milk and dirt will get into the can through such openings. Hence, the final recordings are maximum light porosities (MLP) based on the average of the 3 highest values, one taken from each of 3 sides of the filter.

OBSERVATIONS AND DISCUSSION

The practice was to select for the tests several adjacent filters as found in any package at a milk plant. The filters so selected were forwarded to a central office where field tests were first made on one or more of the filters selected at random. After making the field test, usually at least two unused filters from the original selection were sent to Albany for testing using the light meter. It was deemed impracticable to make laboratory determinations of light porosities on the identical filter aids which were used for field tests and *vice versa*.

The results, consisting of determinations using field tests, of light porosity measurements, and of weights per square yard of the materials, have been tabulated to determine whether or not there might be some relationship between the observations. The observations on the woven flannel filters (thread count usually 38-40 warp x 36-38 fill, with some exceptions having a thread count of 48 x 42), and the different types of unwoven cotton discs have been grouped with respect to increasing maximum light porosity determinations. The results of tests also have been grouped according to the type of metal strainer used, (1) some

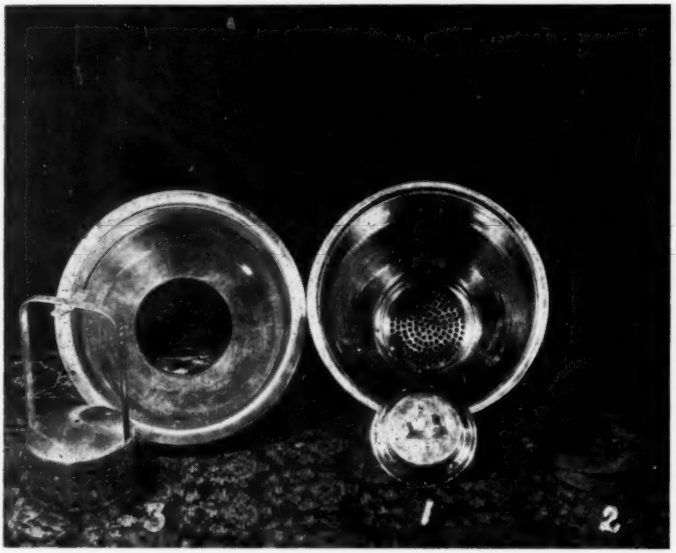

FIGURE 6—THREE GENERAL TYPES OF STRAINERS

1. Perforated metal bottom with protecting metal disc.
2. Clamps to be attached to open bottom strainer at left to hold filter aid externally to bottom of strainer.
3. Open bottom strainer with internal dome to hold filter aid internally in strainer.

strainers being equipped with a perforated metal disc to support the filter aid, (2) some without a support (open bottom) but with an external clamp to hold the filter aid, and (3) some without a support (open bottom) but with a dome serving as an internal clamp to hold the filter aid, see Fig. 6. All references to a strainer with a perforated bottom assume that the filter rests directly on the perforated area.

COTTON FLANNELS

The maximum light porosities (MLP), see Table 2, on 37 cotton flannels, using the perforated bottom strainer, range from 26.3 to 35.7 foot candles. In general, as the light porosities increase, the weight per square yard of the material decreases. The field tests on corresponding filters were Satisfactory in 30 instances and Fair in 7. The 6 bleached flannels among the 37 examined weighed slightly more than unbleached flannels having approximately the same maximum light porosity values. Although distinctively more absorbent, the results of field tests using the bleached flannels were satisfactory with respect to the removal of sediment.

Using an open bottom strainer with an external clamp, the MLP among 25 cotton flannels ranged from 26.7 to 35.3 foot candles. Seventeen field tests were Satisfactory, 2 Fair, and 6 Poor. When the results are listed in the order of increasing MLP values, the break between the Satisfactory tests and the Fair tests occurred at about 31.0 foot candles.

Using an open bottom strainer with an internal clamp, the MLP ranged from 26.3 to 36.7 foot candles among

TABLE 2

RESULTS BY FIELD TESTS COMPARED WITH LIGHT POROSITY TESTS

Type of strainer	No. of tests	Range of max. light porosities * ft. candles	Results by field tests			
			Satisfactory	Fair	Poor	Record incomplete
Flannels						
Perforated bottom	37	26.3–35.7	30	7	0	0
Open bottom, external clamp	18	26.7–31.0	16	0	2	0
	3	31.1–32.0	1	2	0	0
	4	32.1–35.3	0	0	4	0
Open bottom, internal clamp	16	26.3–32.0	16	0	0	0
	3	32.1–33.0	0	3	0	0
	12	33.1–36.7	1	7	4	0
Cotton pads — double gauze faced						
Perforated bottom	28	33.0–38.7	28	0	0	0
Open bottom, external clamp	17	34.7–38.0	13	2	0	2
Open bottom, internal clamp	4	34.7–37.3	4	0	0	0
Cotton pads — single gauze faced						
Perforated bottom	17	37.0–39.7	14	3	0	0
Open bottom, external clamp	12	38.0–38.7	0	4	4	4
Open bottom, internal clamp	15	37.3–39.7	6	4	5	0
Cotton pads — double chemically faced						
Perforated bottom	6	39.5–39.8	6	0	0	0
Open bottom, internal clamp	16	38.7–39.8	2	14	0	0
Cotton pads — plain faced						
Perforated bottom	15	38.7–39.8	11	2	2	0
Open bottom, internal clamp	54	38.7–39.8†	5	9	34	6

* Average of 3 highest values among approximately 120 observations.
† Includes observations on 12 very thin pads in which the distribution of the cotton fibers was exceptionally spotty.

TABLE 3

TESTS ON 120 COTTON FLANNELS LISTED IN THE ORDER OF INCREASING WEIGHT PER SQUARE YARD WITH CORRESPONDING (1) TENSILE STRENGTH OF FILL (17 SAMPLES ONLY), (2) MAXIMUM LIGHT POROSITIES, (3) FIELD EFFICIENCY TESTS AND (4) IDENTITY OF TYPE OF STRAINER USED

Under Field Test: S = Satisfactory, F = Fair, P = Poor and N = Record Incomplete
Under Type of Strainer: PB = Perforated Bottom, OBE = Open Bottom, External Clamp and OBI = Open Bottom, Internal Clamp

Sample	Oz. per sq. yd.	Tensile strength of fill lbs./in.	MLP	Field test	Type of strainer	Sample	Oz. per sq. yd.	Tensile strength of fill lbs./in.	MLP	Field test	Type of strainer
168	3.23		34.3	N		53	3.88		32.7	S	PB
217	3.23		34.7	N		186	3.89		34.0	N	
148	3.24		32.3	N		185	3.90		34.7	N	
55	3.25	25	35.0	S	PB	257	3.92		33.7	N	
79	3.27		35.3	P	OBE	53a	3.94		32.3	S	PB
151	3.28		34.0	N		54	3.94	30	32.0	S	PB

95	3.30		33.0	P	OBE	42	4.04		27.3	S	PB
167	3.30		32.7	N		108	4.10		28.3	S	OBE
218	3.32		32.0	N		58	4.14	30	29.0	F	PB
250	3.32		36.3	F	OBI	76	4.15		28.7	S	OBE
251	3.33		34.7	F	OBI	52	4.17	35	31.0	S	PB
225	3.36		34.3	F	PB	69	4.17		30.0	P	OBE
191	3.37		31.7	N		85	4.17		28.0	S	OBE
150	3.38		33.7	N		70	4.18	27	30.7	P	OBE
122	3.38		33.0	F	OBI	206	4.21		28.7	N	
94	3.40	6.2	33.0	P	OBE	93	4.22	28	28.3	S	OBE
177	3.40	7	31.7	S	OBI	111	4.22		28.3	S	OBE
56	3.41		34.0	S	PB	112	4.24		28.7	S	OBE
248	3.41		34.7	F	OBI	40	4.25		27.3	S	PB
33	3.42		31.7	S	PB	172	4.25		27.7	N	
89	3.42		33.3	P	OBE	231	4.25		27.7	S	PB
247	3.42		35.3	F	OBI	139	4.26		28.0	S	OBI
123	3.43	24	33.3	F	OBI	57	4.27		29.7	F	PB
253	3.44		34.0	P	OBI	90	4.27		27.7	S	OBE
121	3.45		32.3	F	OBI	109	4.27		28.3	S	OBE
197	3.45		31.7	N		242	4.29		27.0	S	PB
240	3.45		32.3	S	PB	86	4.30		26.7	S	OBE
31	3.46	7	31.0	S	PB	133	4.31		29.3	S	OBI
117	3.46		31.0	S	OBI	59	4.34		28.7	F	PB
236	3.46		34.0	F	PB	230	4.34		26.3	S	PB
252	3.46		36.7	P	OBI	244	4.35		28.3	S	PB
44	3.50		31.0	S	PB	89	4.37		27.3	S	OBE
110	3.50	11	30.7	S	OBE	141	4.37		26.3	S	OBI
116	3.51		33.7	P	OBI	241	4.37		26.7	S	PB
136	3.51		32.0	S	OBI	152	4.38		27.3	N	
119	3.52	21	31.7	S	OBI	132	4.39		29.3	S	OBI
120	3.52		34.3	S	OBI	173	4.39		27.3	N	
238	3.52		35.7	F	PB	243	4.39		27.7	S	PB
239	3.52		33.0	S	PB	232	4.40		27.7	S	PB
32	3.53		31.3	S	PB	174	4.40		28.0	N	
149	3.53		31.7	N		246	4.41		30.0	S	OBI
254	3.53		33.3	F	OBI	104	4.42		26.7	S	OBE
255	3.53		32.3	F	OBI	138	4.42		26.7	S	OBI
258	3.53		34.0	N		140	4.43		26.7	S	OBI
43	3.54		30.3	S	PB	41	4.44		26.3	S	PB
237	3.54		34.7	F	PB	234	4.45		29.0	S	PB
245	3.55		31.3	S	PB	249	4.48		26.7	S	OBI
124	3.56		33.7	F	OBI	75	4.49		27.3	S	OBE
45	3.58		31.3	S	PB	105	4.54		27.0	S	OBE
118	3.58	18	30.7	S	OBI	171	4.57		27.0	N	
256	3.58		31.0	S	OBI	103	4.61		26.7	S	OBE
78	3.62		31.3	S	OBE	114	4.61		26.3	S	OBI
115	3.62		34.0	P	OBI	113	4.62		28.3	S	OBI
77	3.64	22	30.3	S	OBE	233	4.62		28.3	S	PB
198	3.64		30.7	N		213	4.65		23.7	N	
82	3.71		31.3	F	OBE	214	4.66		24.0	N	
81	3.78	24	31.7	F	OBE	229	4.70	20	26.3	S	PB
50	3.80		31.7	S	PB	179	4.74		29.7	N	
51	3.82	24	32.0	S	PB	180	4.78		29.0	N	
259	3.83		34.3	N		205	4.94		28.7	N	

31 flannels. The results of 17 field tests were Satisfactory, 10 Fair, and 4 Poor. The break between Satisfactory and Fair tests in this group occurred at about 32.0 foot candles. Despite this record, the need for a flannel having a maximum light porosity not greater than 31.0 foot candles is obvious since no one can assure what type of strainer will be used with the flannels.

DOUBLE GAUZE FACED COTTON PADS

Field tests, using double gauze faced cotton pads (DGF) in a perforated bottom strainer, see Table 2, were Satisfactory with each of the 28 pads tested. The MLP values ranged from 33.0 to 38.7 foot candles. Using an open bottom strainer with an external clamp, the MLP among the 17 DGF pads examined ranged from 34.7 to 38.0 foot candles. Among the 15 pads subjected to field tests, 13 were Satisfactory and 2 Fair. All 4 tests using DGF pads in an open bottom strainer with an internal clamp were Satisfactory.

SINGLE GAUZE FACED COTTON PADS

The range of the MLP values among the 17 single gauze faced pads (SGF) in which the perforated bottom strainer was used was from 37.0 to 39.7 foot candles, see Table 2. Fourteen of the field tests were Satisfactory and 3 Fair. Among the 8 completed tests using SGF pads in an open bottom strainer with an external clamp, none were Satisfactory, 4 were Fair, and 4 were Poor. The MLP on 15 SGF pads tested in an open bottom strainer ranged from 37.3 to 39.7 foot candles. Among the field tests, 6 were Satisfactory, 4 Fair, and 5 Poor.

Unless the manufacturer of the single gauze faced cotton pad can assure that it will not be used in an open bottom strainer, it is obvious that Satisfactory results can not always be expected.

CHEMICALLY FACED PADS

Each of the 6 chemically faced pads (CF) gave Satisfactory field tests in a perforated bottom strainer, see Table 2. The MLP values among the 6 pads ranged from 39.5 to 39.8. Of the 16 CF pads tested in an open bottom strainer with an internal clamp, 2 were Satisfactory and 14 Fair. The MLP values for CF pads ranged from 38.7 to 39.8 foot candles.

Unless the manufacturer of the chemically faced pads can assure that they will be used in a perforated bottom strainer, it is obvious that Satisfactory results cannot be expected.

PLAIN COTTON PADS, WITHOUT FACINGS

Among the 15 plain cotton pads (PC) tested in the field, the results were 11 Satisfactory, 2 Fair and 2 Poor, see Table 2. The MLP values among these pads ranged from 38.7 to 39.8. Of the 4 plain cotton pads tested in an open bottom strainer with an internal clamp, 5 were Satisfactory, 9 Fair and 34 Poor. Field tests were incomplete in 6 instances. The MLP values ranged from 38.7 to 39.8 foot candles. In 14 cases the light meter readings were recorded as unsatisfactory because of the extremely thin pad and the reflecting properties of the fibers themselves which in many instances caused MLP values to exceed 40 foot candles. These practically worthless pads were among the poorest of the filter aids tested.

WEIGHT PER SQUARE YARD OF FLANNELS

Results of tests on 120 flannels are listed in Table 3 in the order of increasing weight per unit area, the range being from 3.23 to 4.94 oz. per square yard. Among 43 flannels weighing more than 4 oz. per square yard, 12 percent of the field tests are either Fair or Poor. Among the 50 flannels weighing less than 4 oz. per square yard, 52 percent were Satisfactory.

TABLE 4

FREQUENCY DISTRIBUTION TABLE SHOWING RELATIONSHIP OF WEIGHT PER SQUARE YARD TO MAXIMUM LIGHT POROSITY VALUES AMONG 120 WOVEN COTTON FLANNELS

Range of oz. per sq. yd.	Range of Maximum Light Porosities														
	23.0 to 23.9	24.0 to 24.9	25.0 to 25.9	26.0 to 26.9	27.0 to 27.9	28.0 to 28.9	29.0 to 29.9	30.0 to 30.9	31.0 to 31.9	32.0 to 32.9	33.0 to 33.9	34.0 to 34.9	35.0 to 35.9	36.0 to 36.9	Total
3.20–3.39	..	..	..	..	..	..	..	..	1	3	3	5	2	1	15
3.40–3.59	..	..	..	..	..	..	..	3	12	4	7	7	2	1	36
3.60–3.79	..	..	..	..	..	..	..	2	3	..	..	1	..	..	6
3.80–3.99	..	..	..	..	..	..	..	..	1	4	1	3	..	..	9
4.00–4.19	..	..	..	..	1	3	1	2	1	..	..	..	..	..	8
4.20–4.39	..	..	..	4	9	8	3	..	..	..	..	..	..	..	24
4.40–4.59	..	..	..	5	4	1	1	1	..	..	..	..	..	..	12
4.60–4.79	1	1	..	3	..	2	2	..	..	..	..	..	..	..	9
4.80–4.99	..	..	..	..	..	1	..	..	..	..	..	..	..	..	1
Total	1	1	0	12	14	15	7	8	18	11	11	16	4	2	120

TABLE 5

TESTS ON 72 DOUBLE FACED COTTON DISCS LISTED IN THE ORDER OF INCREASING WEIGHT PER SQUARE YARD WITH CORRESPONDING (1) MAXIMUM LIGHT POROSITIES, (2) FIELD EFFICIENCY TESTS AND (3) IDENTITY OF TYPE OF STRAINER USED.

Under Field Test: S = Satisfactory, F = Fair and N = Record Incomplete
Under Type of Strainer: PB = Perforated Bottom, OBE = Open Bottom, External Clamp and OBI = Open Bottom, Internal Clamp

Sample	Oz. per sq. yd.	MLP	Field test	Type of strainer	Sample	Oz. per sq. yd.	MLP	Field test	Type of strainer
195	2.52	37.7	N		24	3.16	36.3	S	PB
156	2.56	39.7	N		60	3.16	35.0	S	PB
157	2.65	39.3	N		170	3.16	35.7	N	
30	2.85	38.0	S	PB	341	3.16	37.0	S	OBE
38	2.85	38.3	S	PB	193	3.19	36.0	N	
169	2.88	36.0	N		23	3.20	36.0	S	PB
20	2.89	38.7	S	PB	61	3.20	35.3	S	PB
28	2.89	37.3	S	PB	106	3.20	37.0	S	OBE
165	2.89	38.3	N		135	3.20	36.3	S	OBI
37	2.90	38.7	S	PB	46	3.22	36.7	S	PB
134	2.90	37.3	S	OBI	71	3.22	35.3	F	OBE
175	2.90	38.3	N		146	3.25	34.7	N	
27	2.91	38.3	S	PB	48	3.26	35.3	S	PB
21	2.95	38.7	S	PB	64	3.30	37.0	S	PB
35	2.98	34.0	S	PB	25	3.31	36.0	S	PB
29	2.99	38.3	S	PB	145	3.32	34.7	S	OBI
63	3.00	38.0	S	PB	147	3.32	35.0	N	
73	3.00	36.0	S	OBE	166	3.32	37.7	N	
74	3.00	36.3	S	OBE	203	3.32	36.7	N	
39	3.02	37.7	S	PB	204	3.33	36.0	N	
34	3.03	33.0	S	PB	87	3.36	36.0	S	OBE
36	3.03	33.3	S	PB	99	3.36	35.7	S	OBE
62	3.05	38.0	S	PB	88	3.38	35.3	S	OBE
342	3.06	37.7	S	OBE	65	3.39	36.0	S	PB
201	3.08	38.0	N		215	3.40	35.0	N	
72	3.09	36.3	F	OBE	22	3.41	36.3	S	PB
100	3.10	37.3	S	OBE	96	3.42	35.3	N*	
102	3.10	38.0	S	OBE	211	3.47	34.7	N	
202	3.10	38.3	N		154	3.49	36.0	N	
26	3.11	38.0	S	PB	144	3.52	35.0	S	OBI
176	3.11	38.8	N		49	3.56	34.7	S	PB
177	3.12	36.0	N		210	3.58	35.0	N	
178	3.12	37.3	N		98	3.62	35.0	S	OBE
19	3.13	38.0	S	PB	47	3.64	35.0	S	PB
101	3.14	37.7	S	OBE	209	3.66	35.3	N	
107	3.14	37.3	S	OBE	97	3.72	34.7	N*	

*N = Cannot be held by external clamp.

Despite this overlapping distribution of the tests with reference to weight and since 16 of the tests among the 26 flannels weighing less than 4 oz. per square yard, were made in perforated bottom strainers, it appears that in order to assure generally satisfactory sediment tests, flannels should weigh not less than 4 oz. per square yard.

Table 4 shows with one exception that flannels weighing more than 4 oz. per square yard have MLP values exceeding 31 foot candles. With only 5 exceptions, flannels weighing less than 4 oz. per square yard have MLP values under 31 foot candles. This general relationship of weight per square yard to results both of field tests and of light porosity determinations is particularly noteworthy.

TENSILE STRENGTH OF FILL IN FLANNELS

Because of the apparent inconsistencies among the 120 flannels, Table 3, with relation to Satisfactory field tests when the flannels weighed less than 4 oz. per square yard, 17 were selected on which breaking strengths were determined using the Grab test. Determinations were based on the average of the results of 2 breaks only. Grab tests on the warp were relatively uniform, being approximately 80 lbs. per inch. Grab tests on the fill among the 17 flannels, see Table 3, disclose that as the weight per square yard increases there is generally an accompanying increase in the tensile strength of the fill.

Close observation of Samples 55, 119 and 123, which had relatively high tear strengths for light weight flannels, showed that they were poorly napped and the napping was uneven. Despite the poor napping and the light weight, 2 of these 3 gave Satisfactory field tests and 1 Fair. According to the MLP values all 3 samples would have been disqualified. There are other inconsistencies where the MLP values are low and the field test Satisfactory, despite a low weight per square yard and a low tensile strength value. It is possible in some instances that field tests were made on individual specimens which were superior to those subjected to laboratory tests. Regardless of the correct explanation, it is obvious that if a light weight flannel is also poorly napped, the MLP values are generally greater and the field tests are less apt to be Satisfactory.

The successful use of flannels to remove dirt depends to a large measure upon the degree and the uniformity of napping. Too much napping, such as described as a full nap, retards the flow of milk to such a degree that the use of full-napped flannels would be impractical. A relatively heavy weight flannel with a poorly napped and tightly twisted fill in many cases would be less satisfactory than a lighter weight flannel with a medium nap teased from less tightly twisted fill. Unless the interstices between the warp and fill are reasonably well covered with the nap, the sediment will pass more freely through the unobstructed areas. At the same time the tensile strength of the warp and fill should be such as to permit no separation of the threads. Excessive napping of light weight flannel may weaken it to such a degree that it will be less satisfactory, particularly when used in open bottom strainers.

Judging from these observations recorded in Table 3, it is apparent that the tensile strength of the fill should be not less than about 22 lbs./in. and that of the warp be not less than about 80 lbs./in. Although a tensile strength determination is informative, it is not advisable to depend solely upon it as a criterion of efficiency.

WEIGHT PER SQUARE YARD OF DOUBLE FACED COTTON PADS

Among the 72 double faced cotton discs listed in Table 5, the weight ranged from 2.52 to 3.72 oz. per square yard. Although there was a slight decrease in the MLP values as the weight per square yard increased, the difference was immaterial. The results of

field tests in general were satisfactory. Table 6 shows a frequency grouping of the observations in terms of MLP values and of weights per square yard. Although there must be a limit in weight per square yard for DGF pads beyond which field tests would be unsatisfactory, the present records do not indicate where the distinction should be made.

WEIGHT PER SQUARE YARD OF SINGLE FACED COTTON PADS

The weight of the 52 single faced cotton pads (Table 7) range from 1.72 to 3.13 oz. per square yard. Similarly as in Table 5, the MLP values decreased slightly as the weight increased. Among the field tests, 16 were Satisfactory, 10 were Fair, 9 were Poor, and 18 Incomplete. Table 8 shows a frequency grouping of the SGF filters in terms of their MLP values and their weights per square yard.

WEIGHT PER SQUARE YARD OF DOUBLE CHEMICALLY FACED COTTON PADS

Among the 22 samples listed in Table 9, the weight ranged from 1.93 to 2.54 oz. per square yard. The MLP values were confined to a very narrow range of from 39.3 to 39.8 foot candles. Seven field tests were Satisfactory and the remaining 15 were Fair.

WEIGHT PER SQUARE YARD OF PLAIN COTTON PADS

The weights of the 58 pads listed in Table 10 ranged from 1.32 to 2.55 oz. per square yard. The MLP values were confined to a narrow range. Eight of the field tests were Satisfactory, 11 Fair, 33 Poor, and 6 incomplete.

SUMMARY AND CONCLUSIONS

One or more tests have been applied to 120 woven cotton flannels, 72 double gauze faced (cotton) pads, 52 single gauze faced pads, 22 double chemically faced pads and 58 plain faced pads.

None of the cotton flannels were well napped and invariably the napping was not uniform, thereby creating spots which were distinctively measurable in terms of maximum light porosity values. Some flannels were distinctively better napped than others, resulting both in fewer and smaller spots.

None of the pads or discs were entirely uniform, as revealed by variations in light porosity values. Although a maximum light porosity value must exist for pads, even including those protected by double gauze facings, beyond which field tests using a standard sediment mixture are likely to be unsatisfactory, it is apparent that the efficiency of cotton pads is more directly related to other properties of the pad than it is to properties which influence light porosity values.

Woven cotton flannels weighing not less than 4 oz. per square yard, with light-medium to medium napping, with maximum light porosity values not exceeding 31 foot candles, with warp strength not less than 80 lbs. per inch and with fill strength not less than 22 lbs. per inch are generally satisfactory in all types of strainers.

Double gauze faced unwoven cotton pads are generally satisfactory in all types of strainers.

Single gauze faced unwoven cotton pads are generally less satisfactory than double gauze faced pads, particularly so in strainers without filter aid supports. Even when the single gauze faced pads are used with the gauze face down in a perforated bottom strainer, the results on 3 among 17 field tests, nearly 18 percent, were not satisfactory.

Double chemically faced cotton pads are generally unsatisfactory unless used in perforated bottom strainers. When used in an open bottom strainer, the results on 14 among 16 pads subjected to field tests, about 87.5 percent, were Fair.

Plain pads or pads without facing are generally unsatisfactory. Even when used in a perforated bottom

strainer, the results on 4 among 15 field tests, nearly 27 percent, were not satisfactory.

Discs without gauze facings are generally less satisfactory than those with double gauze facings in all types of strainers.

Since neither the manufacturer of the filter aid nor the manufacturer of the strainer can guarantee the type of filter aid that will be used in the strainer by the farmer, it follows then that the only safe policy is to provide a filter aid which will work efficiently in all types of metal strainers. Furthermore, since neither the manufacturer of the strainer nor the manufacturer of the filter aid, who sometimes implies that some of his aids are more effective for the removal of certain types of soil than other types, can guarantee in all cases that the more porous filter aid will not be used when the less porous one should be used, it behooves the manufacturer to make only one grade of filter aid, one which will assure as completely as possible the removal of all soil, including even that which is most difficult to remove.

A strainer with a perforated bottom, designed so that the perforated area supports the filter aid, and with a cup (or dome) baffle to protect and to hold the filter in a fixed position offers the best assurance of satisfactory results regardless of the type of filter aid used. When the poorest types of filters are used even in such a strainer, many of the tests are apt to be unsatisfactory.

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TABLE 6

FREQUENCY DISTRIBUTION TABLE SHOWING RELATIONSHIP OF WEIGHT PER SQUARE YARD TO MAXIMUM LIGHT POROSITY VALUES AMONG 72 DOUBLE FACED GAUZE PADS

Range of oz. per sq. yd.	*Range of Maximum Light Porosities*							*Total*
	33.0 to 33.9	*34.0 to 34.9*	*35.0 to 35.9*	*36.0 to 36.9*	*37.0 to 37.9*	*38.0 to 38.9*	*39.0 to 39.9*	
2.40–2.59	..	..	..	..	1	..	1	2
2.60–2.79	..	..	..	..	..	..	1	1
2.80–2.99	..	1	..	1	2	9	..	13
3.00–3.19	2	..	2	6	7	8	..	25
3.20–3.39	..	2	6	8	3	..	..	19
3.40–3.59	..	2	4	2	..	..	..	8
3.60–3.79	..	1	3	..	..	..	..	4
Total	2	6	15	17	13	17	2	72

TABLE 7

TESTS ON 52 SINGLE FACED COTTON PADS LISTED IN THE ORDER OF INCREASING WEIGHT PER SQUARE YARD WITH CORRESPONDING (1) MAXIMUM LIGHT POROSITIES, (2) FIELD EFFICIENCY TESTS, AND (3) IDENTITY OF TYPE OF STRAINER USED

Under Field Test: S = Satisfactory, F = Fair, P = Poor and N = Record Incomplete

Under Type of Strainer: PB = Perforated Bottom, OBE = Open Bottom, External Clamp and OBI = Open Bottom, Internal Clamp

Sample	*Oz. per sq. yd.*	*MLP*	*Field test*	*Type of strainer*	*Sample*	*Oz. per sq. yd.*	*MLP*	*Field test*	*Type of strainer*
340	1.72	38.8	F	OBE	161	2.63	39.2	N	
339	1.76	39.0	P	OBE	126	2.66	39.3	P	OBI
207	2.18	39.8	N		281	2.70	39.3	S	PB
208	2.20	39.8	N		284	2.71	38.3	S	PB
125	2.34	39.7	P	OBI	320	2.73	39.0	F	OBI
189	2.37	39.0	N		353	2.75	39.5	S	PB
130	2.42	38.3	S	OBI	91	2.77	38.0	P	OBE
131	2.42	38.0	S	OBI	200	2.80	36.7	N	
128	2.44	39.7	P	OBI	319	2.82	38.3	S	OBI
143	2.47	38.0	F	OBI	351	2.82	38.7	S	PB
181	2.47	38.7	N		160	2.83	34.7	N	
84	2.48	39.5	N		322	2.84	38.7	S	OBI
323	2.49	39.7	S	OBI	129	2.86	38.8	P	OBI
352	2.49	39.3	S	PB	199	2.86	37.3	N	
142	2.50	37.3	F	OBI	337	2.86	35.3	F	OBE
318	2.50	39.7	S	OBI	364	2.86	37.3	F	PB
83	2.52	39.3	N		188	2.87	38.7	N	
182	2.52	38.3	N		163	2.88	35.0	N	
127	2.54	39.5	P	OBI	338	2.90	35.7	F	OBE
92	2.56	38.3	P	OBE	162	2.93	36.7	N	
321	2.56	39.5	F	OBI	363	2.95	37.7	F	PB
280	2.57	39.5	S	PB	365	2.95	37.0	S	PB
283	2.57	39.7	S	PB	362	2.97	37.3	S	PB
350	2.57	39.3	F	PB	183	3.00	35.7	N	
343	2.60	38.7	P	OBE	187	3.02	36.7	N	
282	2.62	39.5	S	PB	184	3.13	36.3	N	

TABLE 8

FREQUENCY DISTRIBUTION TABLE SHOWING RELATIONSHIP OF WEIGHT PER SQUARE YARD TO MAXIMUM LIGHT POROSITY VALUES AMONG 52 SINGLE FACED GAUZE PADS

Range of oz. per sq. yd.	*Range of Maximum Light Porosities*						*Total*
	34.0 to 34.9	*35.0 to 35.9*	*36.0 to 36.9*	*37.0 to 37.9*	*38.0 to 38.9*	*39.0 to 39.9*	
1.60–1.79	..	..	..	..	1	1	2
1.80–1.99	..	..	..	..	..	..	0
2.00–2.19	..	..	..	..	..	1	1
2.20–2.39	..	..	..	..	..	3	3
2.40–2.59	..	..	..	1	6	11	18
2.60–2.79	..	..	..	..	3	6	9
2.80–2.99	1	3	2	5	5	..	16
3.00–3.19	..	1	2	..	..	..	3
Total	1	4	4	6	15	22	52

TABLE 9

TESTS ON 22 DOUBLE CHEMICALLY (PLASTICIZED) FACED PADS LISTED IN THE ORDER OF INCREASING WEIGHT PER SQUARE YARD WITH CORRESPONDING (1) MAXIMUM LIGHT POROSITIES, (2) FIELD EFFICIENCY TESTS AND (3) IDENTITY OF TYPE OF STRAINER USED

Under Field Test: S = Satisfactory and F = Fair
Under Type of Strainer: PB = Perforated Bottom and OBI = Open Bottom, Internal Clamp

Sample	Oz. per sq. yd.	MLP	Field test	Type of strainer	Sample	Oz. per sq. yd.	MLP	Field test	Type of strainer
221	1.93	39.5	F	OBI	260	2.27	39.5	S	PB
222	2.00	39.7	F	OBI	262	2.28	39.8	S	PB
219	2.03	38.7	F	OBI	265	2.29	39.5	S	PB
223	2.12	39.7	F	OBI	261	2.34	39.7	S	PB
263	2.12	39.7	S	PB	267	2.37	39.7	F	OBI
224	2.13	39.5	F	OBI	227	2.38	39.3	F	OBI
220	2.17	39.3	F	OBI	266	2.45	39.7	F	OBI
225	2.18	39.5	S	OBI	270	2.47	39.5	F	OBI
228	2.18	39.3	F	OBI	271	2.48	39.7	F	OBI
264	2.21	39.5	S	PB	268	2.51	39.5	F	OBI
226	2.24	39.5	S	OBI	269	2.54	39.8	F	OBI

TABLE 10

TESTS ON 58 PLAIN FACED COTTON PADS LISTED IN THE ORDER OF INCREASING WEIGHT PER SQUARE YARD WITH CORRESPONDING (1) MAXIMUM LIGHT POROSITIES, (2) FIELD EFFICIENCY TESTS AND (3) IDENTITY OF TYPE OF STRAINER USED

Under Field Test: S = Satisfactory, F = Fair, P = Poor and N = Record Incomplete
Under Type of Strainer: PB= Perforated Bottom and OBI = Open Bottom, Internal Clamp

Sample	Oz. per sq. yd.	MLP *	Field test	Type of strainer	Sample	Oz. per sq. yd.	MLP *	Field test	Type of strainer
345	1.32	39.7	P	PB	314	2.08	39.5	P**	OBI
346	1.35	39.8	F	PB	308	2.09	39.8	F	OBI
357	1.36	39.8	P**	OBI	306	2.10	39.7	P	OBI
358	1.39	39.5	P**	OBI	277	2.11	39.7	P**	OBI
359	1.39	39.7	P**	OBI	273	2.12	39.8	S	PB
347	1.42	39.3	F	PB	307	2.13	39.7	P	OBI
356	1.43	39.7	P**	OBI	312	2.13	39.5	P**	OBI
344	1.53	38.7	S	PB	311	2.15	39.3	P**	OBI
302	1.56		N		315	2.15	39.2	N	
295	1.57		P**	OBI	310	2.16	39.7	P	OBI
301	1.57		N	OBI	317	2.16	38.7	N	
290	1.58		F	OBI	276	2.19	39.2	P**	OBI
296	1.58		F	OBI	272	2.20	39.5	S	PB
291	1.59		P	OBI	313	2.20	39.2	P**	OBI
292	1.60		P	OBI	329	2.24	39.8	F	OBI
293	1.60		P**	OBI	326	2.32	39.8	F	OBI
294	1.61		P	OBI	274	2.33	38.7	S	PB
289	1.63		P**	OBI	327	2.33	39.8	F	OBI
298	1.69		P**	OBI	325	2.37	39.8	F	OBI
297	1.73		P	OBI	275	2.38	39.8	P**	OBI
299	1.74		P	OBI	328	2.38	39.7	S	OBI
300	1.79		P	OBI	331	2.45	39.2	P**	OBI
303	1.89	39.8	P**	OBI	335	2.48	39.5	P**	OBI
304	1.98	39.8	F	OBI	324	2.50	39.8	S	OBI
279	1.99	39.3	S	PB	333	2.51	39.8	P**	OBI
305	2.03	39.8	F	OBI	330	2.52	39.2	P**	OBI
316	2.07	39.3	N		332	2.54	39.3	P**	OBI
278	2.08	39.7	S	OBI	334	2.55	39.7	P**	OBI
309	2.08	39.7	P	OBI	336	2.55	39.3	N	

* Readings unsatisfactory for MLP values on samples 289 to 302.
** Pad broke during use.

Manual of Sanitation Standards for Certain Products of Paper, Paper Board, or Molded Pulp

Preface

This Manual of Sanitary Standards for Certain Products of Paper, Paper Board, or Molded Pulp has been compiled as a result of prolonged conferences and studies of several groups working together for the purpose of ascertaining standards to guide manufacturers of certain paper products that are used to package liquid and moist foods for human consumption. The three groups which cooperated on this were (a) federal, state, and local health officials, (b) members of the Department of Plant Sciences of Syracuse University, and (c) representatives of the manufacturers concerned. The advice, counsel, and cooperation of several public health officials in various parts of the country have been received through correspondence. Three have participated in several conferences, for the most part held at Syracuse University. These officials are Mr. A. W. Fuchs, Sanitary Engineer Director, United States Public Health Service, Washington, D. C.; Mr. Walter D. Tiedeman, Chief, Bureau of Milk and Restaurant Sanitation, State Department of Health, Albany, New York; Dr. Milton R. Fisher, Chief of Milk Control, Department of Public Welfare, St. Louis, Missouri.

Syracuse University provides facilities to the manufacturers of these products for the testing of their raw materials and finished products to determine whether or not they meet the Manual requirements. Another service that the University will provide is, on request of the manufacturer, the inspection of his plant through the Department of Plant Sciences. The results of these investigations and inspections will be made available to interested health officials.

Syracuse University is well fitted to render the above services as it has a Department of Plant Sciences and the New York State College of Forestry, which includes pulp and paper manufacturing.

It is recognized that this Manual is only a beginning. Much factual information is needed before further steps can be made. The three groups which participated in the development of this Manual have, therefore, agreed that it will remain in effect until August 1, 1948, and that it will then be reviewed. Suggestions for change will be considered in conference and through correspondence. It is of necessity a live document, subject to amendment and correction to meet changing conditions and to reflect benefits to be gained from experience, research, and investigation.

Definitions

The following definitions shall be employed in the application and interpretation of these *Sanitation Standards:*

1. *Sanitation standards* is a statement of objectives in the interest of public health patterned after regulations and standards promulgated by official agencies.

2. The term *these products* shall mean the following products constructed in whole or in part from paper, paperboard, or molded pulp used for packaging or serving liquid or moist ready-to-eat foods and drinks for human consumption:

(a) Milk bottles.
(b) Milk bottle caps, hoods, and closures.
(c) Round, nested paper cups, containers and covers.
(d) Spirally wound cylindrical liquid-tight containers.

3. The term "Liquid or Moist Ready-to-Eat Foods and Drinks for Human Consumption" includes but is not limited to the following:

(a) *Milk products* which shall mean and include the following when packaged: cream, sour cream, skimmed milk, milk beverages, skimmed milk beverages, reconstituted or recombined milk, reconstituted or recombined cream, buttermilk, cultured buttermilk, vitamin D milk, homogenized milk, soft curd milk, goat milk, and similar ready-to-eat foods which are within the purview of ordinances relating to milk products.

(b) *Frozen desserts* which shall mean and include the following when packaged or served: ice cream, frozen custard, frozen milk, frozen cream, ice milk, milk sherbet, and ices.

(c) *Other liquid or moist ready-to-eat foods and beverages* when packaged or served.

4. *Clean, sanitary stock* shall mean any paper, paperboard, or molded pulp made from the following materials:

(a) Clean and sanitary virgin chemical or mechanical pulp.

(b) A stock which is composed of clean, sanitary virgin broke, waste or cuttings from the original mill or fabricating plant, and other clean and sanitary stock.

5. *Broke and waste or cuttings* are paper and paperboard that have been discarded anywhere in the process of manufacture such as on the paper-making machine and in the form of trim. Similar products in fabricating plants are called waste or cuttings.

6. The term *slime spots* means the defects in paper and paperboard due to microbiological growths and products of growth.

7. *Bacteriological Standards.* All bacteriological examinations carried out under these *Standards* shall be made and reported in conformity with the latest edition of *Standard Methods for the Examination of Dairy Products* and other applicable standard methods published by the American Public Health Association.

MANUFACTURING OPERATIONS

Item I. *Poisonous and Deleterious Substances Prohibited.* All materials used in the manufacture of *these products* shall be free from substances which may render the food injurious to health or which may impair the flavor, odor, composition, or bacteriological quality of the food.

Paper packages shall meet the requirements and conform to the sanitary standards required for food containers as set forth in the Federal Food, Drug, and Cosmetic Act.

Item II. *Fabrication from Clean, Sanitory Stock. These products* shall be made from clean, sanitary stock properly protected from contamination and free from slime spots.

Item III. *Adhesives Free from Poisonous, Malodorous, or Injurious Substances.* Adhesives employed in fabricating *these products* shall not impart odor to contents of packages, and shall not contaminate *the food* with microorganisms or any poisonous or injurious substances. Adhesives shall be stored, handled, and used in a sanitary manner.

Item IV. *Moisture-Resistant Materials.* Moisture-resistant materials when used for *these products* shall be free from substances which may render the food injurious to health or impart an odor or taste to the food. Moisture-resistant materials, when used, shall render *these products* adequately impervious to the transmission of liquids through the package material or through the package. Moisture-resistant materials shall not crack open, slough off, flake, nor pull away from treated surfaces to a degree which would render the food injurious to health.

Item V. *Protection from Contamination. These products* shall be handled, wrapped, packaged, trans-

ported, and stored in such manner as to prevent contamination.

All surfaces of *these products* coming in contact with food shall be protected from damage and exposure to contamination and shall be handled in a sanitary manner. For protection from contamination during shipping and storage, well constructed shipping containers shall be used which can be tightly closed and sealed.

Item VI. *Bacteriological Standards. These products* shall comply with the following standards:

(a) Materials used and *these products* shall be free from coliform bacteria.

(b) By rinse or contact tests, surfaces of *these products* which come in contact with the food shall yield not more than one colony per one square centimeter.

(c) When *these products* are used for the packaging of milk or "milk products" as defined in the *Milk Ordinance and Code* recommended by the U. S. Public Health Service (*Public Health Bulletin* No. 220, 1939 Edition, as amended). *These products* shall conform to the bacteriological standards specified in that Code.

Item VII. *Sampling.* Compliance with *sanitation standards* shall be determined by bacteriological examination of *these products.* Bacteriological examination of *these products* shall be made each calendar quarter.

Item VIII. *Plant Sanitation. These products* shall be manufactured in a fabricating plant which is maintained and operated in a clean and sanitary manner, in clean and sanitary surroundings under adequate insect, rodent, and vermin control.

These products shall be protected from contamination by microorganisms, dirt, grease, splashing water, refuse, food residues, insects, rodents and other animals, and insanitary handling by operators. Fabricating plants shall meet the following requirements:

(a) *Plant Surroundings.* The immediate surroundings of plants shall be kept in a clean and sanitary condition.

(b) *Buildings and Rooms.* The buildings and rooms in which *these products* are fabricated, handled, packed, and stored shall be clean, well lighted (natural or artificial) and ventilated, and free from dirt, insects, rodents, and other animals. Where fumes are present, rooms shall be equipped with hoods or exhaust fans.

(c) *Water Supply.* The water supply shall be easily accessible, adequate, and of safe sanitary quality. There shall be no cross connection between a safe water supply and an unsafe water supply. Bacteriologically, water shall meet United States Public Health Service standards for water used on interstate carriers or the requirements of the province (Dominion of Canada) wherein the plant is located.

(d) *Floors and Corners.* Floors and corners shall be kept clean and free from scrap and waste materials. Trim, converter waste, and cuttings which are intended to be re-used as defined in paragraphs 4 (b) and 5, shall be collected in clean receptacles or conveyed automatically to a room suitable for baling stock of high sanitary quality. Clean metal guards or other suitable devices shall be used to prevent contamination of in-process materials by contact with floors. Floors shall be kept in good repair and accessible for cleaning.

(e) *Machines and Other Mechanical Equipment.* Machines, units and appurtenances with which paper, blanks, materials, and packaging come in contact shall not contaminate *these products.* Machines, units, and parts thereof shall be kept reasonably free from accumulations of fiber. Contamination of materials used and *these products* by dirt, grease, and dripping oil shall be prevented. Temporary makeshift devices that may contaminate the product shall be avoided. Where

feasible, unnecessary overhead structures shall be eliminated.

(f) *Hand-Washing Facilities.* Handwashing facilities shall be conveniently located and readily accessible, shall be provided with hot and cold running water, liquid soap or soap powder delivered from dispensers, individual cloth or paper towels, and suitable receptacles for disposal of towels, cleansing tissue, etc. Fixtures operated by foot, knee, or elbow are advised. The use of a common towel is prohibited.

Clearly legible signs shall be posted conspicuously in each toilet room instructing employees to wash their hands before returning to work. The common drinking glass and insanitary drinking facilities shall be eliminated.

(g) *Toilet Facilities.* Toilet facilities shall comply with local or state ordinances; shall be kept clean, well-ventilated, and in good repair.

(1) Toilet rooms shall be free from flies and shall not open directly into rooms where paper or paperboard products are fabricated, handled, or stored.

(2) Toilet room doors shall be self-closing; a room or enclosure open at the top is not satisfactory.

(3) Toilet rooms shall not be used for storage of clothing, shoes, or lunches.

(4) Toilet rooms shall be used only by operators for whom facilities are intended.

(h) *Lunching Facilities and Disposal of Food Residues.* Lunching at machines, in washrooms, and wherever materials and *these products* are held, fabricated, and stored shall not be permitted. Proper facilities shall be maintained for disposal of food scraps and bottles containing residues of milk and other drinks. Distribution and accumulation about plant of food residues, bottles, and other containers of food and drink shall be prohibited.

Item IX. *Personnel, Cleanliness and Health.* All persons coming in contact with materials used and *these products* shall handle them in a clean and sanitary manner; all such persons shall, (a) wear clean outer garments, (b) wash hands thoroughly with soap and water and dry them on a clean towel before commencing work, (c) wash hands thoroughly with soap and water and dry them on a clean towel before resuming work after visiting the toilet, and (d) keep the hands clean at all times while engaged in this work. Female employees shall confine the hair by means of a cap or net. Any person with acute contagious or infectious disease, receiving medication and/or requiring bandaging of fingers shall be promptly relieved of any connection with the manufacture of *these products* until, under advice of physician, all public health and sanitation hazards have been removed.

July 16, 1947

CURRENT INVESTIGATIONS OF LABORATORY METHODS USED IN MILK AND FOOD UTENSIL SANITATION

(Continued from page 12)

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5. Scharer, H. Personal communication (July 28, 1943).

6. Weber, G. R. and Black, L. A. Inhibitors for Neutralizing the Germicidal Action of Quaternary Ammonium Compounds. *J. Bact.* **54**, 44 (1947).

PLANT INSPECTION REPORT

NAME OF PLANT..... ADDRESS.....

INSPECTION NO..... DATE..... DATE OF LAST INSPECTION.....

Sir: An inspection of your plant has this day been made and your attention is called to the items marked below with a cross (×).

Item No.

1. *Harmful Substances Prohibited.* (1a) Adulteration of foods—No possibility of foods becoming contaminated with substances injurious to health ( ), harmful adulterants ( ), questionable materials ( )..... ( )

(1b) Packaging materials and containers—free from slime spots ( ), odors ( ), tastes ( )..... ( )

2. *Paper and Paperboard.* Made from clean, sanitary, virgin stock only ( ), made at adjacent mill and protected ( ), received wrapped and sealed ( ), outside sheets discarded immediately prior to fabrication ( )..... ( )

3. *Adhesives.* Non-poisonous ( ), dried films odorless ( ) and tasteless ( ), do not contaminate food ( ), resistant to decomposition ( ) and leaching ( ), stored, handled, and used in sanitary manner ( )..... ( )

4. *Moisture-Resistant Materials.* Materials are impervious to liquids ( ), are odorless ( ), tasteless ( ), nonpoisonous ( ), do not crack open ( ), slough-off ( ), flake-off ( ), pull away ( )..... ( )

5. *Protection from Contamination.* (5a) Surfaces coming in contact with foods—protected at all times from damage ( ) and from exposure to contamination ( ) ..... ( )

(5b) Fabricated products protected during shipping and storage—by well constructed shipping containers ( ), tightly closed ( ), sealed ( )..... ( )

6. *Bacteriological Standards.* Free from coliform bacteria ( ), not more than one colony per one sq. centimeter ( ), conforms to bacteriological standards in U.S.P.H.S. *Milk Ordinance and Code* ( )..... ( )

7. *Plant Sanitation.* (7a) Plant surroundings—immediate surroundings clean and sanitary..... ( )

(7b) Buildings and rooms—clean ( ), well lighted and ventilated ( ), free from dirt, insects, and vermin ( ), devices used for removal of fumes and dust ( )..... ( )

(7c) Water supply—easily accessible ( ), adequate ( ), of safe sanitary quality ( ), no cross connections ( ) ..... ( )

(7d) Floors and corners—kept clean ( ), cuttings handled and baled in sanitary manner ( ), stock protected from contact with floors ( ), floors tight and kept in good repair ( ), accessible for cleaning ( )..... ( )

(7e) Machines and units—accessible for cleaning ( ), are kept clean ( ), maintained and operated without objectionable make-shift devices ( ) ..... ( )
Unnecessary overhead structures eliminated ..... ( )

(7f) Manual handling—products handled mechanically wherever possible ..... ( )

(7g) Hand-washing facilities—convenient and accessible ( ), warm running water ( ), soap, liquid or powder ( ), individual towels and suitable disposal receptacles ( ), washing signs ( )..... ( )

(7h) Toilet facilities—conform to local or state ordinances ( ), clean ( ), ventilated ( ), good repair ( ), free of flies ( ), doors self-closing ( ), no direct opening ( ), no storage ( ), for persons intended ( )..... ( )

(7i) Lunching facilities—room suitable for purpose ( ), kept clean and sanitary ( ), prompt disposal of food residues, waste, etc. ( )..... ( )

8. *Personnel, Cleanliness and Health.* No person with infectious disease, infection of hands, skin or scalp ( ), wear clean, washable outer garments ( ), hands clean ( ), hair confined by cap or net ( )..... ( )

Manager of Plant.....

Inspector .....

An Improved Stain for the Direct Microscopic Examination of Milk

MANLEY MANDEL [1]

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In the course of an investigation of the failure of the Breed direct microscopic examination to disclose the presence of "physiologically old" coliform organisms seeded in milk, an improved milk stain containing the cationic surface-active agent, cetyl pyridinium chloride, was developed. The results of this investigation of the phenomenon first reported by Whitehead (1) will be published at a later date. It is the purpose of this note to present the advantages and the preparation of the aforementioned stain.

When replicate slides of milk samples seeded with 24 hour cultures of coliform organisms were stained with Breed's stain, Mallman's acid stain, and the new stain, the slides stained with the latter stain yielded significantly higher counts, in closer correlation with the standard plate counts, than the direct counts where the former stains were employed. In addition to yielding higher counts on seeded milk samples, the procedure was especially advantageous in the examination of raw milk samples where rod form organisms constituted an appreciable proportion of the population. Further advantages of the staining procedure were the decolorization of the background, providing heightened contrast between bacteria and background, and preparations uniformly free of surface debris even when month-old preparations of the staining solution were used.

Preparation of milk films. Milk films may be prepared either by the methods appearing in *Standard Methods for the Examination of Dairy Products,* 8th edition, or by the method of Bryan, Mallmann, and Turney (2). Slides are air dried and fixed in heat.

Staining procedures. The milk film is defatted by one minute immersion in xylene. The excess xylene is drained from the slide and the slide is rinsed one minute in 95 percent ethanol, drained and immersed one minute in the staining solution. The reverse side of the slide is briefly immersed in a gentle stream of water to remove the excess stain, drained, and dried.

Preparation of the staining solution. To 10 ml. of saturated alcoholic methylene blue chloride (certified for bacteriological use), add 0.034 gm. cetyl pyridinium chloride and make up to 100 ml. with 30 percent ethanol. The cetyl pyridinium chloride may be conveniently added as 3.4 ml. of a 10 percent aqueous solution.

Microscopic appearance of the stained milk films. The bacteria appear dark blue or black and the leucocytes and epithelial cells appear blue against a colorless or very pale blue background. The crest of the smear retains the stain more heavily than the remainder of the smear, permitting ease in focusing the microscope. No destaining of the milk films has been found necessary in the author's experience.

The staining procedure described above has been used by the author with good results. Extensive comparisons of the procedure with stains other than

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the Breed stain have not been completed at this writing. Presentation of the technique at this time, however, is made so that others may avail themselves of the method.

REFERENCES

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2. Bryan, C. S., Mallmann, W. L. and Turney, G. J. Some Microscopic Technics for Determining the Bacteriological Quality of Milk. *Mich. Agr. Exper. Sta.*, Circ. Bull. 186 (1944).

THE ORANGE COUNTY MILK SANITARIANS ASSOCIATION

The Orange County (N. Y.) Milk Sanitarians Association, entering its fourth year, is a large and active infant in the family of milk sanitarians organizations. Started in 1944, at the time of writing it has a membership of 124. Its present officers are George H. Decker, Liberty, N. Y., president; Andrew J. Tompkins, Middletown, N. Y., vice-president; Howard B. Marlatt, Middletown, N. Y., secretary; and Dr. Harry C. Temple, Pine Bush, N. Y., treasurer. Executive Committee members, other than the officers, are Paul L. Brooks, Middletown, Erik Lundstedt, Goshen, and Samuel Abraham, Middletown.

The scope of the organization is somewhat broader than its name would indicate. The membership, according to its constitution, is made up " of persons actively engaged in sanitary milk control or in some phase of the dairy industry." While a majority of its members are Orange County residents, it has members in New Jersey, Pennsylvania, and New York City.

Its object, which is being effectively accomplished, is " to assist its members to more efficiently discharge their responsibilities, to bring them together for discussion of recent information revealed in the fields of practice, to develop more uniform and efficient supervision of milk and its products, and to promote good fellowship."

Meetings are held four times a year. At a meeting in February, 1947, at which your reporter had the privilege of being a speaker, Dr. H. W. Sherman and Dr. William A. Hagen, of Cornell University, were among the other speakers. The fact that the meeting was held in a church hall and during a blizzard had no apparent effect on either attendance or enthusiasm.

The last meeting was held in Middletown on December 12, 1947. The subject discussed was " Specification and Operation of Can Washers," the speakers being Clarence W. Weber, New York State Department of Health, Albany, and R. L. Batchelor, The Lathrop-Paulson Company, New York City.

P. B. B.

The Inspection of Meat *

C. H. PALS, *Assistant Chief, Meat Inspection Division*
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I am happy to have this opportunity of meeting with your association and sharing in the discussions of food-inspection problems.

Dr. Shrader has asked that I make some comments regarding meat inspection before we view the film "Meats With Approval." This film, released by the U. S. Department of Agriculture, tells how the Federal meat-inspection law came into being, how it is administered and what it means to the consumer in terms of health and safety. Beginning at the turn of the century when it was not uncommon for illness, sometimes even death, to follow the eating of tainted food, the film relates that many realized the need for some kind of control over the preparation and marketing of food yet were powerless to do anything to correct the condition.

After Upton Sinclair wrote "The Jungle" charging unwholesome practices in the handling of meat, many more became aroused and demanded that the government take action. In 1906 a law requiring government control of meat inspection, re-inspection and supervision of processing and labeling was passed.

The picture shows the many steps in Federal inspection, from the live animal through the slaughterhouse and cannery.

The film is being distributed through educational film libraries for the use of farm organizations and various civic, professional and consumer groups.

The need for some control over the meat we eat was recognized thousands of years ago, when Moses handed down certain dietary laws for the Hebrew people. The inspection made by the rabbis was probably the earliest form of meat inspection. These early laws of Moses form the basis of some of the dietary laws observed by different religious groups today. Great strides have been made in veterinary science in the last fifty to seventy-five years, and we now have a scientific basis for the laws and regulations pertaining to meat inspection.

The early meat-inspection laws were designed to facilitate the exportation of meat to foreign countries and did not afford much protection to the citizens of the United States. As a result of the great clamor for an improved system of meat inspection, in order to correct some of the appalling conditions which existed in the meat industry, Congress passed the Meat Inspection Act, which became effective July 1, 1906. Our present Federal Meat Inspection Regulations were issued under the authority of this Act and succeeding acts. The principal purpose, as stated in the Act is ". . . for the purpose of preventing the use in interstate or foreign commerce . . . of meat and meat food products which are unsound, unhealthful, unwholesome, or otherwise unfit for human food. . . ."

PURPOSE AND SCOPE

The major purposes of the present system of Federal meat inspection may be itemized further as follows: (1) to examine food animals including cattle, calves, sheep, swine, goats, and horses prior to slaughter to eliminate diseased animals; (2) to conduct a thorough post mortem examination of each amimal at the time of slaughter to search out and eliminate diseased and

* Presented at the thirty-fourth annual meeting of the INTERNATIONAL ASSOCIATION OF MILK SANITARIANS, Milwaukee, Wis., October 16–18, 1947.

otherwise unfit meat; (3) to destroy for food purposes diseased and otherwise unfit meat; (4) to see that meat and meat food products are kept clean and wholesome during the stages of preparation into articles of food; (5) to guard against the use of harmful preservatives and other deleterious ingredients; (6) to cause sound and wholesome meat and meat food products to be marked as having been "inspected and passed"; (7) to require informative labeling and to prevent the use of false and deceptice labeling on meat and meat food products; (8) to certify meat and meat food products for export; (9) to inspect meat and meat food products offered for importation into this country; (10) to examine meat and meat food products for compliance with specification requirements of governmental purchasing agencies and (11) to assure proper post mortem diagnosis and disposition of carcasses in unusual cases. Research is conducted on the methods of treatment of carcasses and tissues to meet the requirements of the meat-inspection regulations. Research is also conducted on abnormal conditions in meat and its products through investigations of feeding, management and packing procedures and of diseases or parasites to which the conditions might be attributed.

Contrary to the belief of a large segment of our population not all meat sold in retail stores is federally inspected. A report issued by the Bureau of Agricultural Economics of the De-

U.S.D.A. Photograph by Knell

Two Federal veterinary meat inspectors, working on either side of a moving-top viscera inspection table, examine the internal organs taken from the hog carcasses hanging up in the rear. Every carcass whose viscera show signs of any pathological or other unfit condition is identified by a "U. S. RETAINED" tag and segregated for a later closer veterinary examination. Special tags, numbered in duplicate, are attached to each retained carcass and the viscera taken from it.

partment of Agriculture indicates that only about two-thirds of the animals slaughtered for food in this country have been examined by the inspectors of the Federal Government. It is estimated that in 1946, 33,398,000 cattle, calves, sheep and hogs were slaughtered in plants not operating under Federal inspection and 16,131,000 animals were slaughtered on the farm. Some of these animals were slaughtered in plants operated under State, county or municipal inspection, but we are safe in saying that many millions of animals received no inspection whatsoever. Since approximately 7 percent of all animals slaughtered for food under Federal inspection are found to be affected with some abnormal or diseased condition, which is seldom apparent except to an especially trained inspector, it is necessary that each animal slaughtered for food purposes be given a thorough inspection. As meat and meat products are highly perishable and may be readily contaminated, their processing, preparing and packing should be conducted in adequately equipped plants under close inspectional supervision.

During the past year, our inspectors found it necessary to condemn over 332,000 animals and carcasses and over 1,292,000 parts of carcasses. Also over 9,000,000 pounds of meat and meat food products were condemned as being unfit for food because of its having become sour, tainted, rancid, unclean, or otherwise unfit for human food. These figures represent information obtained in the course of our work in Federal meat inspection. It is very possible that if information were available regarding the health of animals not slaughtered under Federal meat inspection, the percentage might be even higher. When inspection is conducted in a plant to enable it to ship its product in interstate or foreign commerce, the entire production of the plant is subject to inspection, regardless of the proportion shipped in interstate or foreign trade.

Effective July 1, 1947, the cost of Federal Meat inspection was placed under a system of fees to be paid by packers and others receiving the service. Under this system the Department of Agriculture continues to pay its inspectors, as in the past, but is collecting the cost from those served. The same thoroughness and economy of inspection prevails under the new system as in the past. The inspector's employment rights as a Civil Service employee are in no way diminished and he retains all his present rights under his present appointment, such as retirement, leave, within-grade promotions, etc. He continues to be paid by U. S. Treasury checks and there is no change in his relation to the management or other personnel in an inspected meat-packing establishment.

INSPECTION REQUIREMENTS

The kind of inspection necessary to assure a clean and wholesome meat supply is different from any other food-control program. To be fit for human food, meat must be derived from healthy animals and prepared under conditions which will prevent contamination. The health of each animal is of primary concern. This can be ascertained only by an examination of each animal prior to slaughter and an examination of the viscera and carcass at the time of slaughter to eliminate any portion that is diseased or otherwise unfit.

The ante mortem and post mortem inspection of meat animals is essentially a veterinary function. Veterinarians are trained in the various sciences such as chemistry, physiology, pathology, parasitology, and in clinical medicine, to qualify them for making diagnoses and for evaluating the various conditions which might affect the wholesomeness of meat and meat by-products. Trained lay assistants may detect and retain animals and carcasses that appear to be abnormal for disposition by a veterinarian. All steps

in the preparation, packing and labeling of meat and meat food products are supervised by trained meat inspectors. To assure cleanliness of all operations, it is essential that proper facilities be provided. These include (1) an ample supply of potable water, both hot and cold, well distributed throughout the plant under adequate pressure and in quantities sufficient for all operating needs; (2) provision for the proper handling of sewage and all wastes to prevent any nuisance from developing in or near the establishment; (3) floors, walls and ceilings constructed of material that can be readily kept clean; (4) floors well sloped to properly trapped and vented floor drains; (5) an abundant supply of natural light and supplemented by artificial light when natural light is inadequate; (6) suitable ventilation for all work rooms and (7) equipment which is so located and constructed that it can be readily kept clean. Only clean outer garments of washable material should be worn by persons handling meat. In order to assure personal cleanliness of all employees, it is necessary that suitable facilities be provided. Some of the most essential are conveniently - located hand - washing facilities supplied with hot and cold running water, soap and towels. Suitable welfare rooms should also be provided. These rooms should be well lighted and ventilated and equipped with lockers, hand-washing facilities, and separate rooms for toilets and urinals.

All operations should be conducted in a cleanly manner with due regard for preventing contact of meat with hides, diseased material and the contents of sinuses, digestive tract and the udder.

It is well known that sick animals are sometimes sent to the slaughtering plant in an attempt to salvage meat which might otherwise be lost. A competent ante mortem inspection is the only assurance that some of these animals will not find their way into food channels rather than to the fertilizer plant. Any system of meat inspection should include a thorough examination of all food animals on the day of salughter. Animals which plainly show that they are affected with a disease or condition which would make them unsuitable for food should be condemned and not permitted to be slaughtered. In order to conduct a satisfactory ante mortem inspection, it is necessary that the inspector have proper facilities for making the inspection. These should include adequate light and adequate equipment and assistance for restraining any animals which require close inspection.

The conduct of a thorough post mortem examination requires different facilities according to the species being slaughtered. Regardless of the species being slaughtered, provision should be made for handling the carcass and all parts in such a manner that diseased carcasses and parts will not contact other carcasses and to permit the handling of the carcasses and parts in a manner which would prevent any contamination.

Suitable facilities should be provided for maintaining the identity of all parts with the corresponding carcass until the entire inspection has been completed. Suitable metal tables or trucks which can be cleaned after each use should be provided for holding the viscera for inspection. The inspection procedure is adapted to the volume of slaughter and to the type of equipment which is provided. In smaller layouts, one inspector is able to perform the entire inspection whereas in some of the larger units it is necessary to have as many as seven or more inspectors regularly assigned. The inspection on each carcass should be thorough and is varied according to the species of animal and to the possible diseased conditions which may be encountered. As an example, the examination of beef includes a search for evidence of the

cystic form of one of the human tapeworms, *Taenia saginata*. Since the preferred location of the cyst is in the more active muscles, such as those of the cheek, heart, and diaphragm, these muscles are given close attention and are incised during the inspection. Other parasites detected by incision are the flukes and tapeworms, which may be found in the bile ducts. Some of the bacterial diseases such as tuberculosis may be found by palpating the lymph nodes which are the preferred seats of infection. Some of these lesions, however, are found only by carefully incising the various lymphnodes and organs.

Carcasses should be clean when presented for inspection. Particular emphasis is given to the removal of all hair, scurf, and dirt from hog carcasses, and to the proper cleaning of calf carcasses which may be dressed with the hide on.

It is essential that all diseased or otherwise unfit carcasses and parts be effectively destroyed for human food. Most establishments that have a sufficiently large volume of slaughter are equipped with facilities for rendering the condemned and inedible material into inedible product. At plants which are not equipped with such rendering facilities, the condemned carcasses and parts may be made unfit for human body by freely slashing and denaturing with crude carbolic acid or other effective denaturant.

Those carcasses and parts which are found to be fit for human food should be identified with markings which will show that they have been inspected and passed. The agency conducting the inspection should be identified on the markings. The marking fluid which is used on the carcasses and parts should be harmless and of a kind which will maintain the identity of the product.

In order to prevent spoilage, carcasses and parts should be placed under refrigeration as soon as possible after slaughter. The refrigerated rooms should be equipped with suitable trolleys or hooks which will permit the carcasses to be thoroughly chilled in a short time without becoming contaminated in any manner. The rails should be sufficiently high and so located that the meat will not contact the floors, walls or other equipment.

The meat inspector should be assured that no harmful preservatives or other deleterious ingredients are used on the meat or product. The preservatives which are permitted to be used in establishments operating under Federal meat inspection are very limited and when used, information regarding the amount and kind of preservatives used is prominently displayed on the product or label. In this regard special attention has been given during the past few years for the use of certain antioxidants in lard and other shortening with the result that the keeping quality of these products has been greatly improved without impairing their qaulity and food value.

The supervision of the processing of meat and meat byproducts requires a thorough knowledge of these operations. There has been a marked increase in the last several years in the amount of sour cured meat which is found in packing plants. This is due largely to the improved sanitation and to the use of curing methods which result in a product being ready for the trade in a much shorter time than was possible when the older methods were used. Too much emphasis cannot be given to the effect that good sanitation has on the keeping qualities of meat food products. Particular attention should be given to the thorough cleaning of all equipment which comes in contact with meat. Properly constructed metal equipment is much preferred over wooden equipment. Now that stainless steel and other rust-resisting metals are more readily available, the use of equipment which is difficult to maintain in a sanitary condition should be discouraged. Prepared

products, such as sausage, loaves and the like, should be informatively marked and labeled. Such markings should include information regarding the identity of the product and the ingredients which were used in the manufacture of the article.

A well-operated meat inspection system will fill a very valuable place in the livestock disease control program. Centers of infection are often traceable when disease conditions are detected in the course of slaughter. The information obtained by the meat inspector may be transmitted to the livestock sanitary official having jurisdiction and it is then possible for him to take the necessary measures to eradicate or control the particular disease in the area.

In conclusion, a competent system of meat inspection must have as its keystone the ante mortem and post mortem inspection of each animal and carcass. Each step in the slaughtering operation and any subsequent processing must be closely supervised. The inspector must be definitely conscious of the need for having adequate facilities for the purpose of inspection and maintenance of sanitary conditions. There is no substitute for such inspection.

WASHINGTON STATE COLLEGE

17th ANNUAL INSTITUTE OF DAIRYING

March 8 - 13, 1948

The seventeenth annual meeting of the Institute of Dairying, State College of Washington, will be held at Pullman, March 8-13, 1948. Dr. P. H. Tracy of the University of Illinois, President of the American Dairy Science Association and winner of the Borden Award, will address the convention. Other authoritative speakers on the program will deal with quality milk production, new methods of milk collection, processing, laboratory and field control, efficient plant arrangement and design, new and improved types of plant equipment, problems of management and labor, marketing and manufacturing of all types of dairy products, the utilization of byproducts, and other practical topics.

A dairy products scoring contest, "open to the world", will be a feature with judging contests, prizes, and quality clinics.

The Washington Creamery Operators Association will hold its annual meeting at the time of the institute, and President Ray McKenna of Centralia and Managing Director Ray Miller of Seattle urge a full attendance of operators. Business meetings will also be held by the Washington Milk Dealers Association and the Washington Ice Cream Manufacturers Association according to Mr. A. Frank Bird, Secretary, Seattle, and other organizations such as the Washington State Dairy Council, the State Department of Agriculture, and the State Department of Health will cooperate in the program.

Anyone interested in any phase of the dairy industry is cordially invited to participate. A tuition of $5.00 for the entire week or $2.50 per day will be charged to help defray the expenses of the Institute. Make reservations early either with the Washington Hotel, Pullman, Washington, or Professor C. C. Prouty of the Department of Dairy Husbandry.

For a detailed program, when completed, and all other particulars, write to Dr. H. A. Bendixen, Department of Dairy Husbandry, W. S. C. Pullman, Washington.

The Time Factor in High-Temperature Short-Time Pasteurizing*

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TIME and temperature are interdependent factors in the destruction of bacteria by heat. In the process known as high-temperature short-time pasteurization, the time-temperature conditions are 15 seconds and 160°F respectively. These are the conditions specified in the U. S. Public Health Service milk ordinance and substantially the same as those included in most state and local regulations. It has been shown by Weber,[1] in a review of the literature concerning the death of pathogenic bacteria of significance in milk by heat treatment, that this time temperature combination is not an absolute minimum. There appears to be included in this specification a safety zone of at least 9 seconds when 160°F is used and conversely of at least 5°F if the time is 15 seconds. Consequently there appears to be no need for an increase in either the time or temperature beyond those margins established by the fluctuations of the pasteurizer controls.

UNSATISFACTORY TIME CONTROL

The control of the time factor has neither received the attention nor undergone the development that has accrued to the control of temperature. There is intended no implication that perfection prevails in temperature control. Inspection of high-temperature short-time pasteurizers indicates that some will permit the forward flow of milk at temperatures less than the legal minimum. This condition is usually correctable by simple adjustment of the control instrument and is not the result of improper design nor lack of knowledge of the technique necessary for its detection. Pasteurizers of this type are normally equipped with thermometers accurate within ½°F and devices which both record the temperature throughout the entire operation and prevent the entrance of underheated milk into the pasteurized milk reservoir.

The same condition does not obtain with respect to the time factor. To date there has been reported no technique or device applicable to routine testing which will, with accuracy, determine the holding time of milk in high-temperature short-time pasteurizers. Neither are there available devices which will perform for time control functions similar to those of the recording thermometer and the milk flow stop.

In the absence of these controls, dependence has been placed upon other devices to assure a holding time of 15 seconds. In high-temperature short-time units, the holding time is the travel time of the fastest particle through the holder. Control is effected by sealing the pump at a speed which furnishes the proper holding time, but the determination of the holding period involves no standardized or generally accepted technique. It is the purpose of this paper to present certain experimental data on holding time testing and its application to routine inspection.

It would appear that a pasteurizer

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delivering a quantity of milk in 15 seconds equivalent to the capacity of the holder would fulfill the time requirement. It is well known that such a conclusion is erroneous. Flow velocities vary from the center to the pipe wall due to friction. Channeled flow results from the introduction of milk from a small pipe into the larger holding tube. Foam accumulation, resulting from air leaks and the escape of dissolved air upon heating, tends to reduce the effective cross sectional area of the holding tube. These and perhaps other factors make the travel time of the fastest particle less than the average velocity. Among the methods proposed for determining the holding time has been the measurement of the volume delivered for a time interval. By use of the formula

$$\frac{\text{capacity of holder}}{\text{volume delivered}} \times \text{time} = \text{Average holding time}$$

the average holding time may be computed but the travel time of the fastest particle is not given.

Other methods have involved the introduction of a traceable foreign substance. The 1939 edition of the Public Health Service milk ordinance and code [2] includes the timing of the interval between the injection of a dye solution such as fluorescein at the holder inlet and its appearance at the holder outlet as a suggested method for the determination of the holding time. This method has the limitation that the end point is difficult to detect and for that reason has in many places been supplanted by the salt injection technique reported by Fay and Fraser [3] Both tests are restricted to water in their application unless the adulteration of milk is permitted. It then becomes necessary to assume that water and milk have nearly identical behavior if the water results are to be used in timing the unit. It will be shown that this assumption is erroneous by unpredictable amounts.

Another method of testing has been to measure the time of travel of slugs of milk having a temperature different from that normally prevailing in the holder tube. Thomasson [4] has suggested the injection of cold milk with a measurement of the time interval between injection and a deflection of the thermometer at the outlet. A variation has been used in the development of automatic timers which record the time of travel of a slug of hot milk produced by a momentary by-passing of the temperature controller. These techniques possess an advantage in that no foreign substance is being introduced but it is obvious that, since the end point is determined by thermometric response, the quantities involved are far in excess of the particulate dimension specified.

USE OF SALT TEST

Of the testing techniques suggested, the salt test appears to present the closest approach to the criteria of tracing a single particle through the holding tube. The measurement of volume delivered and the temperature fluctuation methods appear to be the only tests applicable to milk. If an empirical correction could be established for either or both of these latter methods, it should be possible to determine the holding time of milk with a fair degree of accuracy. In these studies the results obtained from salt injection tests by the technique described below were used as the basis of comparison.

Test Technique. Test fluid was injected by means of a small hand-operated piston pump with the stem etched to indicate length of stroke necessary to deliver 50, 100, and 150 ml. quantities. The timing was started when the needle movement of a Meters Inc. model 35 d.c. milliameter indicated an increase in the conductance of the liquid crossing the electrodes at the entrance of the holding tube. The end of the holding time was similarly in-

dicated by response to the change in conductance in the liquid crossing electrodes at the holder outlet. The milliameter was wired in series with a variable resistance to permit compensation for the conductance of water. The electrodes consisted of the severed ends of a standard 18 gauge rubber-covered copper wire. The area exposed was the cross-section of the wire and the distance of separation was the thickness of the insulation. The contact surface was located opposite to the direction of flow. Timing was by manually operated stop watches and the end points were the first indication of movement by the milliameter needle.

This instrument was found to give results entirely comparable with the Sol-u-bridge but a somewhat slower response was noted by an automatic timer. This was attributed to the larger amount of current required to energize the relays which operated the timer clock. The difference in time between two instruments varied from 0.9 to 3.50 seconds. This difference increased with decreasing velocity of flow.

COMPARISON OF SALT TEST WITH COLD INJECTION

To compare the salt test with the cold injection test reported by Thomasson, a series of tests were run using injections of a saturated saline at 30°F ± 2°F. Quantities of 50, 100, and 150 ml. were injected and the time of travel determined by the changes in conductance as indicated by the milliameter and the change in temperature as indicated by both indicating and recording thermometers. Usually 5 trials were made for each size injection. The results reported here are tests on 9 pasteurizers, varying in rated capacity from 10,000—30,000 lbs. per hour.

It is conceivable that the injection of fluid into the holding tube could increase the velocity of flow. To determine the significance of this potential error the experimental results were tabulated to indicate the relation between the quantity of injectant and the holding time. In Table 1, it will be noted that the average difference in holding time between the 50 and 150 ml. injections is only 0.15 second. Consequently, it was concluded that variations within the range of 50—150 ml. had but little effect upon the holding time determination by the salt injection method.

Since it was apparent that the cold fluid injection test would require larger amounts of test fluid to produce a thermometer response than those required for the salt test, it did not follow that the above conclusion would necessarily hold. The results from the series of

TABLE 1

INFLUENCE OF QUANTITY INJECTED UPON THE HOLDING TIME AS DETERMINED BY SALINE INJECTION

Rated capacity of unit, lbs./hr.	*Average holding time when quantity injected was*		
	50 ml	*100 ml*	*150 ml*
10,000	15.7	15.6	15.5
10,000	16.8	16.4	16.4
12,000	20.0	19.9	19.8
15,000	16.6	16.5	16.4
15,000	14.0	14.0	14.0
20,000	15.4	15.4	15.5
20,000	16.4	16.1	15.9
22,000	17.2	17.3	17.3
30,000	15.3	15.3	15.3
Average	16.38	16.28	16.23

test runs using the deflection of the recording thermometer were tabulated and appear in Table 2. It will be noted that the difference between the extremes is 0.41 second and somewhat greater than the difference previously noted. It should also be stated that totally unsatisfactory results were obtained with the 50 ml. quantity in about 50 percent of the units tested, thereby limiting the reported data to the 9 units included in these tables. It is apparent that any empirical correction should be in terms of the quantity of injectant used.

TABLE 2

THE INFLUENCE OF THE QUANTITY INJECTED UPON THE HOLDING TIME AS DETERMINED BY THERMOMETRIC MOVEMENT

Rated capacity of unit, lbs./hr.	*Average holding time when quantity injected was* 50 ml	100 ml	150 ml
10,000	18.4	18.0	17.2
10,000	17.9	17.9	17.4
12,000	22.9	21.8	21.4
15,000	18.2	18.1	17.6
15,000	16.2	15.6	15.8
20,000	17.7	17.3	17.6
20,000	18.6	17.7	18.6
22,000	19.6	20.1	21.0
30,000	17.2	16.6	17.0
Average	18.52	18.12	18.11

COMPARISON WITH THERMOMETRIC RESPONSE

The next procedure was to compare the salt test results with those from thermometric response to ascertain whether a general correction factor could be derived. Table 3 presents the results from comparative tests on 16 units using a 100 ml. injection and readings at the recording thermometer. Experience showed this instrument to be more reliable than the indicating thermometer for this purpose. These results show the mean difference between the salt tests and the cold in-

TABLE 3

THE RELATION BETWEEN THE HOLDING TIME WHEN THE DETERMINATION IS BY SALT INJECTION AND BY THERMOMETRIC RESPONSE

Average holding time by salt injection	*Average holding time by thermometric response*	*Difference*	*Deviation from mean difference*
15.4	17.3	1.9	.09
15.6	18.0	2.4	.59
18.2	20.3	2.1	.29
17.2	19.5	2.3	.49
16.5	18.1	1.6	.21
16.1	17.7	1.6	.21
14.6	17.2	2.6	.79
19.9	21.8	1.9	.09
15.0	16.4	1.4	.41
15.3	16.6	1.3	.51
14.9	16.4	1.5	.31
15.4	16.8	1.4	.41
16.4	17.9	1.5	.31
14.0	15.6	1.6	.21
14.4	17.1	2.7	.89
17.3	20.1	2.8	.99
Mean 16.01	17.82	1.81	

jection tests to be 1.81 seconds. If this were used as a general correction, the maximum error would be 0.99 second and 75 percent of the results would be within a range of 0.51 second.

In these tests, the timing was started with the milliameter needle movement and the difference in elapsed time attributed to the slower response of a thermometer. If this were the only variable, the variation in differences among the units studied could be attributed to the difference in sensitivity of the thermometers. A test series was run on one pasteurizer in which the speed of flow was varied. In this series, the holding time was also computed from the volume delivered. Table 4 indicates that the difference between the salt test time and the cold injection test was not constant but diminished with increasing velocity. Since the volume delivered would be expected to vary with the rate of flow, the correction applied here was proportional. When the computed holding times were multiplied by the factor 0.782, the relation between the first salt injection and volume delivered holding time determinations, it was found that a fair degree of agreement was reached between the holding times determined by the two methods at other velocities.

Up to this point, holding times reported have been averages used without regard for limits of error. In applying the technique of cold fluid injection to milk, some recognition might be given to variations in running a series on a single machine. Limits of accuracy might be arbitrarily established as the summation of the average deviations from the three mean values used in establishing the holding time on milk, but in practice this procedure would only tend to lend confustion to the results. The use of mean values throughout is believed to be adequate protection from gross mistakes due to normal experimental error.

In applying the test to milk, the procedure followed has been to establish an empirical correction for each unit to be tested. A series of from three to five trials are made injecting cold saturated saline. Simultaneous determinations of the holding time are made by both salt and cold injection techniques. The difference between the mean holding times is used as a correction factor when cold milk is injected during pasteurization.

When determining the holding time by use of the volume delivered, gravimetric determinations are made if possible of the amount of water delivered

TABLE 4

RELATION BETWEEN HOLDING TIME DETERMINATIONS BY THE SALT INJECTION, COLD FLUID INJECTION AND VOLUME DELIVERED METHODS WHEN FLOW VELOCITIES ARE VARIED

1	2	3	4	5	6
Average velocity ft./sec.	*Holding time by salt injection*	*Holding time by cold injection*	*Corrected * Holding time cold injection*	*Holding time by volume delivered*	*Corrected ** holding time of volume delivered*
0.67	17.2	19.3	17.2	22.00	17.2
0.66	17.9	21.5	19.4	22.3	17.4
0.624	18.3	....	....	23.6	18.4
0.594	19.2	24.0	21.9	24.8	19.4
0.562	20.5	25.2	23.1	26.2	20.5
0.529	21.5	24.3	22.2	27.8	21.8

* Column 3 minus 2.1
** Column 5 × 0.782

in a time interval and salt tests are run concurrently. The weight of milk delivered is then determined for a similar time interval and the milk holding time estimated by the following equation:

$$\text{Estimated Holding Time} = \frac{W_m}{T_m} \times \frac{T_w}{W_w} \times \frac{T_{s.t.}}{\text{sp. gr. of milk}}$$

When W_m = weight of milk delivered in time Tm
W_w = weight of water delivered in time Tw
$T_{s.t.}$ = the holding time by the salt injection method

RESULTS OF PLANT TESTS

During the past year and a half there has been occasion to use tests to determine the holding time for milk in some 34 different units. In Table 5, it will be noted that comparison of the cold injection test with results from measurement of the volume delivered was possible in 9 plants. Of these, six (3, 6, 9, 11, 19, and 23) showed results comparable within reasonable limits, one

TABLE 5

HOLDING TIME OF HIGH-TEMPERATURE SHORT-TIME PASTEURIZERS ON WATER AND MILK

Plant number	Holding time on water by salt injection	Holding time on milk		Ratio between holding times of milk and water	
		By volume delivered	By cold injection	By volume delivered	By cold injection
1	17.3	18.0	16.3	1.040	0.942
2	14.4	....	14.6	.....	1.014
3	14.0	14.0	13.5	1.000	0.963
4	16.4	....	14.6	.....	0.889
5	15.4	....	15.8	.....	1.026
6	15.1	14.2	14.2	0.940	0.940
7	15.3	....	15.0	.....	0.98
8	18.4	....	16.9	.....	0.917
9	15.3	15.3	15.7	1.000	1.026
10	19.9	....	14.6	.....	0.733
11	14.8	14.7	14.8	0.993	1.000
12	15.9	15.0	15.9	0.943	1.000
13	16.4	....	14.6	.....	0.889
14	17.2	21.4	18.5	1.244	1.075
15	16.7	....	16.1	.....	0.964
16	18.3	....	17.8	.....	0.972
17	15.5	....	14.3	.....	0.922
18	18.7	16.4	....	0.876	.....
19	15.5	15.5	15.8	1.00	1.020
20	18.8	....	17.8	.....	0.946
21	16.2	15.7	....	0.968	.....
22	16.1	14.8	....	0.919	.....
23	24.6	21.6	22.2	0.877	0.902
24	14.9	14.4	....	0.965	.....
25	14.4	13.8	....	0.957	.....
26	16.9	15.6	....	0.923	.....
27	16.9	16.3	....	0.964	.....
28	15.2	15.2	....	1.00	.....
29	16.1	16.7	....	1.037	.....
30	16.2	14.8	....	0.913	.....
31	15.3	17.1	....	1.117	.....
32	16.3	16.86	....	1.035	.....
33	17.4	16.91	....	0.971	.....
34	15.7	13.4	....	0.853	.....

(12) indicated a reduced holding time by the volume-delivered method which was not reflected by the cold injection test, with one unit (1) the reverse was true, and the remaining unit (14) showed an increased holding time by both methods but not by comparable quantities. Since there appears to be little choice between the two methods, data by measurement of the volume delivered has been used in the more recent inspections. It has been found easier to convince the plant operator that the salt test on water does not hold for milk because the pump is delivering more milk than water than to lead him through a maze of empirical corrections.

The results from 34 plants indicated that 13 or 38.3 percent were undertimed. Of these, 5 (2, 3, 11, 24, and 25) showed a sublegal holding period on both milk and water. The condition on these units was attributed to changes in operation since the previous test. Four of these units had pump drives which would tend to speed up with belt wear. The other unit (11) was undertimed by but 0.2 second which is within the range of experimental error. Of the eight which remain, one (34) was due to the use of a cold injection test to time the unit without regard for correction and the other seven could be attributed to no other cause than the failure to account for the difference in the quantities of milk and water delivered at the same pump setting. This difference was not constant among the units tested. The relation between the amount of milk and water delivered appeared to vary from 0.734 to above unity.

There are listed here only the findings under normal operating conditions. More units would show short holding times if all contingencies had been anticipated. Among these contingencies is the holding time during diversion. The solution of this problem is still unsatisfactory in many installations. A usual practice has been to place a restriction in the diversion line to impede flow. If this restriction is sufficient to provide the same rate of flow as that prevailing during forward flow, the pressure within the valve must be the same during both conditions. The pressure during forward flow is the sum of the hydrostatic head and the head loss due to friction in the downstream line. The excess of pressure within the valve during diversion over that of the pasteurized milk immediately downstream must then equal the downstream head loss during forward flow. The pressure differential between raw and pasteurized milk may be considerable. It has not been exceptional to find the leak protection features of the flow diversion valve not operating. Common faults have been to find that oversize gaskets have prevented the opening of the leak escape valves and oversize on one gasket has prevented the other from seating. In view of these conditions, it is questionable whether the hazard of a shortened holding time is greater or less than the hazard of intermixture of raw and pasteurized milk at the flow diversion valve.

Those units which were using an auxiliary pump between the raw supply tank and the regenerator provided a satisfactory holding time under both conditions of operation when this pump was wired through the forward flow circuit only. This assembly however may provide unsatisfactory pressure conditions within the regenerator unless proper controls are employed. It is believed that this problem of holding time during diversion deserves exploration to secure a solution whereby both holding time and pressure conditions within the flow diversion valve are satisfactory.

IMPEDING DEVICES

Another group of contingencies stem from the U. S. Public Health Service Code requirement that the timing be done with all valves and any other flow impeding devices open to

their fullest extent. The present trend of plant operators to include unit processes other than pasteurization in the pasteurizing line has complicated the problem of what constitutes a flow impeding device. In the course of testing units, it has been found that a clarifier in operation may decrease the holding time 1 second beyond the effect of a clarifier at rest and a cooling press may vary in its effect upon the holding time by the same amount depending upon whether coolant is being circulated. This problem becomes magnified when the operator locates a relief clarifier or a restricted by-pass to be used when the bowl of the first clarifier has filled up and cleaning is necessary. The logical pipe assembly would be and usually is to use a three-way valve which will permit milk to flow through either or both lines.

A similar operating situation may occur when milk is homogenized. In one installation the homogenizer was located between the regenerator and heater. Milk was supplied by the metering pump which was equipped with a by-pass to carry excess milk back to the supply tank. Since the setting of the metering pump had yielded a satisfactory holding time and since the by-pass line showed a small but continuous flow of milk, it was momentarily assumed that the situation could not be other than satisfactory. Test revealed that the holding time with the homogenizer was less by approximately one second. This was attributed to a lower head pressure at the pump during homogenization.

Since it is entirely possible for all of these conditions to be present on one unit, it is apparent that the sealed pump speed under these conditions would need to be at a point where the holding time was at least eighteen seconds during unimpeded forward flow or diversion, depending upon which was less. The absence of a positive time control independent of the pump seriously impares the flexibility of high-temperature short-time units. It is believed that time control in high-temperature short-time pasteurizing merits further study.

CONCLUSION

The practice of timing high-temperature short-time units during water runs permits errors of unpredictable magnitude. The variation in the amounts of water and milk delivered at the same pump setting may effect the holding time by as much as 26.7 percent. Because of this condition milk run tests should be used in timing. Both the volume-delivered and temperature-fluctuation techniques appear to have application in extending water run tests to milk by empirical correction.

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H. W. Dusterhoft, Deceased

The Wisconsin and International Associations have lost an active and faithful member in the death December 5th of Herman W. Dusterhoft. He had been sanitary inspector for the City of Waukesha for many years, and was a charter member and the first vice-president of the Wisconsin Association.

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Director, Robert Wilson, Detroit City Health Dept., Detroit
Director, Nelson Hall, Saginaw City Health Dept., Saginaw
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Director, Milo Wilson, Mason County Health Dept., Ludington

Minnesota Dairy Fieldmen and Inspectors Association

President, R. L. Hanson.....Rochester
Vice-President, G. A. Kernkamp.....Owatonna
Secretary-Treasurer, J. C. Olson, Jr., Dairy Bacteriologist, Dairy Division, University of Minnesota, Minneapolis.
Board of Directors: W. B. Combs, J. Hortsch, H. G. Oldfield, G. S. Failing, M. Helmbrecht, and C. Mattson.

New York Association of Milk Sanitarians

President, E. R. Albee.....Buffalo
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Oklahoma Association of Milk Sanitarians

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3rd Vice-President, Dr. Wm. Bishop....Bartlesville
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Virginia Association of Milk Sanitarians

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Secretary-Treasurer, H. Clifford Mitchell, Chief Bureau of Sanitation, City Health Dept., Richmond, Va.
Auditors: G. S. Kennedy, Roanoke; J. D. Hanbury, Portsmouth

Wisconsin Milk Sanitarians' Association

President, Vern P. Melhuish.....Oconomowoc
Vice-President, C. K. Luchterhand.....Madison
Secretary-Treasurer, L. Wayne Brown, State Department of Agriculture, Madison
Directors: R. W. Carnes, W. V. Price
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Associations Which Have Designated the

JOURNAL OF MILK AND FOOD TECHNOLOGY

As Their Official Organ

California Association of Dairy and Milk Sanitarians

President, G. C. McFarland.....Los Angeles
1st Vice-President, A. Reynolds.....Sacramento
2nd Vice-President, Jack Covert.....Los Angeles
Secretary-Treasurer, S. S. Sacksteder, 405 West School Street, Compton.

Central Illinois Dairy Technology Society

President, Robert L. Owen.....Peoria
Vice-President, E. G. Huffer.....Springfield
Treasurer, B. S. Cunningham.....Decatur
Secretary, P. H. Tracy, 102 Dairy Manufacturers, Urbana, Illinois, University of Illinois
Recording Secretary, G. R. Lloyd.....Decatur
Sergeant-at-Arms, E. J. Tarr.....Springfield

Chicago Dairy Technology Society

President, C. A. Abele.....Chicago
Vice-President, F. W. Rayl.....Chicago
Secretary, P. H. Tracy, University of Illinois, Urbana
Treasurer, G. C. Hussander.....Chicago
Sergeant-at-Arms, John Dusansky.....Chicago

Connecticut Association of Dairy and Milk Inspectors

President, E. O. Anderson, University of Connecticut, Storrs.
First Vice-President, Bruce C. Grant..New Britain
Second Vice-President, E. St. J. Baldwin, New London.
Third Vice-President, Alfred W. Fish....Hartford
Secretary-Treasurer, H. C. Goslee. State Office Building, Hartford, Conn.

INDIANAPOLIS DAIRY TECHNOLOGY CLUB

President, Albert Jeffreys.....Indianapolis
Vice-President, Dave Lindner.....Indianapolis
Secretary, Dr. B. E. Horrall, Purdue University, West Lafayette
Assistant Secretary, W. K. Moseley...Indianapolis
Treasurer, Lloyd Hardacre.....Anderson

KANSAS ASSOCIATION OF MILK SANITARIANS

President, Mrs. Doris Van Gundy....Wellington
Vice-President, Ivan Van Nortwick.....Topeka
Secretary-Treasurer, Howard M. Weindel, Kansas State Board of Health, Topeka
Directors: J. R. Mingle, Deputy State Dairy Commissioner, Oakley; Dr. C. F. Kubin, City Milk Sanitarian, McPherson

MASSACHUSETTS MILK INSPECTORS' ASSOCIATION

President, Timothy M. Miller.....Springfield
Vice-President, John J. Corton.....Quincy
Secretary-Treasurer, Robert E. Bemis...Cambridge
Executive Board:
Edward E. Williams.....West Springfield
Henry L. Richard.....Ware
J. J. Donovan.....Brookline

METROPOLITAN DAIRY TECHNOLOGY SOCIETY

President, Richard S. Doughty, Production Manager Janssen Dairies, Hoboken, New Jersey
Vice-President, David X. Clarin, Division Manager Oakite Products, Inc., New York, New York
Sergeant-At-Arms, Fred E. Uetz, Chief Sanitarian Pioneer Ice Cream Co., New York, New York
Secretary-Treasurer, George Frank, N. Y. Agr. Tech. Institute, Farmingdale, L. I., N. Y.

MISSOURI ASSOCIATION OF MILK AND FOOD SANITARIANS

President, Dr. I. H. Baird.....St. Joseph
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PACIFIC NORTHWEST ASSOCIATION OF DAIRY AND MILK INSPECTORS

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Secretary-Treasurer, Frank W. Kehrli, Portland, Ore.

PHILADELPHIA DAIRY TECHNOLOGY SOCIETY

President, Thomas Waddell, Philadelphia Milk Exchange
First Vice-President, W. M. Taylor, Cherry-Burrell Corporation
Second Vice-President, R. K. Lawhorn, Abbotts Dairies, Inc.
Secretary-Treasurer, W. S. Holmes, Dairy Council, Inc.
Assistant Secretary-Treasurer, Miss Jane Collins, Supplee-Wills-Jones Milk Co.

TEXAS ASSOCIATION OF MILK SANITARIANS

President, Taylor Hicks.....San Antonio, Texas
1st Vice-President, F. C. Armstrong, Fort Worth, Texas.
2nd Vice-President, R. N. Hancock, McAllen, Texas.
Secretary-Treasurer, G. G. Hunter, Lubbock, Texas

WEST VIRGINIA ASSOCIATION OF MILK SANITARIANS

Chairman, Donald K. Summers, Charleston 1, W. Va.
Secretary-Treasurer, J. B. Baker, Department of Health, Charleston, W. Va.

Association News

Virginia Association of Milk Sanitarians

The annual meeting of the Virginia Association of Milk Sanitarians will be held at the Hotel Roanoke, Roanoke, Virginia, March 11–12. Among those who will appear on the program will be Dr. J. H. Shrader, Secretary-Treasurer of the International Association of Milk and Food Sanitarians, who will speak on the subject: "The International Association of Milk and Food Sanitarians: Its Accomplishments and its Objectives."

Annual Wisconsin Dairy Manufacturers' Conference

The annual Wisconsin Dairy Manufacturers' Conference will be held at the University of Wisconsin, Madison, on March 17th and 18th. The theme will be "Efficiency". For full information address inquiries to Professor H. C. Jackson, University of Wisconsin, Madison, Wisconsin.

Rowland Joins Missouri Division of Health

Mr. J. L. Rowland, formerly of the Florida State Health Department, has accepted a position in the Section of Environmental Sanitation of the Missouri State Division of Health and reported for work on October 1. Mr. Rowland has been assigned to milk and food sanitation duties.

COMMITTEES—INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS
1948

APPLIED LABORATORY METHODS:

K. G. WECKEL, *Chairman*	University of Wisconsin, Madison 6, Wis.
F. W. BARBER	Sealtest Research Laboratory, Baltimore 17, Md.
PAUL ELLIKER	Oregon State Agricultural College, Corvallis, Ore.
CHRISTIAN JENSEN	N. Dakota Agricutural College, Fargo, N. D.
C. K. JOHNS	Department of Agricuture, Ottawa, Ont., Canada

DAIRY FARM METHODS:

MERLE P. BAKER, *Chairman*	Iowa State College, Ames, Iowa
J. F. BLACKLOCK	Health Dept., Hamilton, Ont.
C. P. BLETCH	Maryland & Virginia Milk Prod. Assoc., Washington, D. C.
L. E. BOBER	Babson Bros., Chicago, Ill.
L. WAYNE BROWN	Wisconsin Dept. of Agriculture, Madison, Wis.
R. L. GRIFFITH	City Health Dept., Oakland 12, Cal.
R. M. C. HARRIS	City Health Bureau, Richmond, Va.
GEO. H. HOPSON	DeLaval Separator Co., New York, N. Y.
M. M. MILLER	U. S. Public Health Service, Dist. 8, Denver, Colorado
E. H. PARFITT	Evaporated Milk Assoc., Chicago, Ill.

COMMUNICABLE DISEASES AFFECTING MAN:

N. O. GUNDERSON, *Chairman*	Commissioner of Health, Rockford, Ill.
R. G. FLOOD	San Francisco Medical Milk Commission, San Francisco, Cal.
J. G. HARDENBERGH	American Veterinary Med. Assoc., Chicago 5, Ill.
C. K. MADER	Board of Health, Kitchener, Ont.
I. A. MERCHANT	Iowa State College, Ames, Iowa

FROZEN DESSERTS SANITATION:

F. W. FABIAN, *Chairman*	Michigan State College, E. Lansing, Mich.
W. C. CAMERON	Dept. of Agriculture, Ottawa, Canada
O. A. GHIGGOILE	State Dept. of Agriculture, Sacramento, Cal.
RALPH E. IRWIN	Irwin's Dairy, Inc., Camp Hill, Pa.
DAVID LEVOWITZ	New Jersey Dairy Laboratories, New Brunswick, N. J.
JOHN M. SCOTT	State Dept. of Agriculture, Gainsville, Fla.

COMMITTEE ON ORDINANCES & REGULATIONS:

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C. A. ABELE	Board of Health, Chicago, Ill.
C. J. BABCOCK	U. S. Dept. of Agriculture, Washington, D. C.
H. L. DELOZIER	City Health Dept., Louisville, Ky.
H. J. DUNSMORE	Calhoun County Health Dept., Battle Creek, Mich.
A. W. FUCHS	U. S. Public Health Service, Washington, D. C.
O. A. GHIGGOILE	State Dept. of Agriculture, Sacramento, Cal.

COMMITTEE ON RESOLUTIONS:

R. G. Ross, *Chairman*	State Health Dept., Oklahoma City, Okla.

All ex-presidents of the Association in attendance at the annual meeting.

SANITARY PROCEDURES:

C. A. ABELE, *Chairman*	Board of Health, Chicago, Ill.
H. E. BREMER	State Dept. of Agriculture, Montpelier, Vt.
E. B. BUCHANAN	Department of Health, New York, N. Y.
PAUL CORASH	Cleveland Health Dept., Cleveland, O.
C. B. DALZELL	Cherry-Burrell Corp., Little Falls, N. Y.
M. R. FISHER	Div. of Health, Dept. of Public Safety, St. Louis, Mo.
A. W. FUCHS	U. S. Public Health Service, Washington, D. C.
O. A. GHIGGOILE	State Dept. of Agriculture, Sacramento, Cal.
I. M. MARTY	City Health Dept., Baltimore, Md.
G. W. PUTNAM	Creamery Package Mfg. Co., Chicago, Ill.
H. K. WEAVERS	State Dept. of Agriculture, Madison, Wis.
C. W. WEBER	State Health Dept., Albany, N. Y.

FOOD HANDLING EQUIPMENT:

C. W. WEBER, *Chairman*	State Health Dept., Albany, N. Y.
C. A. ADELE, *Co-Chairman*	Board of Health, Chicago, Ill.
JOHN ANDREWS	U. S. Public Health Service, Washington, D. C.
PAUL DE KONING	Michigan State College, E. Lansing, Mich.
LEWIS DODSON	City-County Health Dept., Denver, Colo.
JEROME TRICHTER	Health Dept., New York, N. Y.
BURLEY WALKER	State Health Dept., Oklahoma City, Okla.

(Continued from page 4)

and expense of multiple and overlapping requirements and inspections, even to outright inability to enter a distant market." He maintained that "maintenance of restrictions imposed against outside competition is not only contrary to the public interest but is a short-sighted policy from the viewpoint of the ultimate prosperity of the local dairy industry."

Mr. Fuchs urged "uniform standards and uniform interpretations thereof which would make possible the mutual acceptance by one area of inspection reports made by another." He advocated extended adoption of the milk ordinance prepared by the United States Public Health Service and now in growing use in states and municipalities.

The economic aspects of strict requirements of cream production and handling and the limitation of inspection areas were discussed by Dr. Spencer.

"The 'closed market' policy does not result in a higher cost to consumers for fluid milk," said Dr. Spencer. "The extra income for producers is obtained through higher prices for cream than would prevail in an 'open' market. The extra cost of cream is shared by consumers and distributors of fluid cream and sour cream and by manufacturers of ice cream.

"In return for the higher price paid for fluid cream and cream products, consumers in a 'closed' cream market like New York City are supplied with cream of higher quality than is sold in other markets. With some exceptions the cream for a 'closed' market is produced under more sanitary conditions and is at least two days fresher than the cream shipped from greater distances to 'open' cream markets. Just how valuable this quality advantage is, especially as to cream that is used for making ice cream or sour cream is difficult to say."

Dr. Spencer continued:

"Milk produced for use as cream in a 'closed' market is a reserve supply that may be drawn on for use as fluid milk wherever the milk supply from inspected sources is insufficient for all demands. Several times in the last few years the New York milkshed did not supply enough milk to meet the full demand for milk and cream. The supply, however, was adequate, or practically so, for fluid milk alone. It was not necessary to bring in milk from sources not meeting the usual sanitary standards as was done in many 'open' markets."

Journal of Milk and Food Sanitation

MEMBERS of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC., and subscribers to its *Journal of Milk and Food Technology* will soon receive the announcement issue of our new publication (volume 1, number 1) entitled, "Milk and Food Sanitation". We anticipate that succeeding issues will be included for the time being at least, in the parent *Journal of Milk and Food Technology* as a distinct section.

J. H. S.

MARYLAND DAIRY TECHNOLOGY CONFERENCE

Approximately 225 persons attended the Third Annual Dairy Technology Conference at the University of Maryland, December 2-4. The conference featured subjects of interest in the fields of ice cream and market milk and to dairy fieldmen.

The outstanding event of the conference was a joint banquet held December 3rd with the Dairy Technology Society of Maryland and District of Columbia. This was the regular monthly meeting of the Society. Approximately 225 attended the banquet which was featured by remarks by Dr. H. C. Byrd, President, University of Maryland; Dr. R. B. Corbett, Associate Dean of Agriculture, University of Maryland; and by the principal address by Dr. H. C. Trelogan, Assistant to Administrator, Research and Marketing Act, U. S. Dept. of Agriculture, on "The Challenge of Research to Dairy Technologists." G. D. D'Ambrogi, of the Baltimore Health Department, President of the Society, presided at this banquet.

The program for the first day centered about problems in sanitation, production and quality control of ice cream.

Professor C. A. Iverson, Dairy Industry Department, Iowa State College, talked on flavors in ice cream. He recommended that nut flavors be featured more often. Nuts should be chosen for their flavor, eye appeal, and should not become soggy. Careful dry roasting and buttering will develop flavor and crispness. Chocolate flavor in ice cream may be enhanced by combining with mint or fudge. This speaker stated that the ice cream industry should plan now for the labelling law which is in the offing—gradually changing from synthetic to pure flavors in order to avoid the consumer resistance which occurs with any sudden change.

The importance of packaging ice cream for sales appeal was emphasized by V. M. Rabuffo, Editor, Ice Cream Trade Journal. Sales of factory-filled packages are increasing rapidly due to expanding grocery store sales, more home freezers, and greater use of automatic machinery in the plant.

A symposium on frozen dairy products featured C. J. Babcock, Dr. R. W. Bell, and Dr. B. E. Webb, U. S. Department of Agriculture, and P. E. LeFevre, Chestnut Farms Dairy, Washington, D. C. Dr. C. W. England, Stephens Industries, Washington, D. C., was moderator. Col. Babcock stated that homogenized milk frozen and held at minus 17° F. was normal after eleven months of storage. Temperatures of storage higher than those for freezing caused rapid flavor deterioration, whereas lower storage temperatures did not affect the flavor. Frozen, homogenized milk is supplied to all hospital ships and army personnel in the South Pacific area and Alaska. Dr. Bell talked on frozen cream. High quality cream of about 40 percent fat should be heated as high as possible without development of an undesirable cooked flavor. Clumping of fat globules is avoided by rapid freezing, after which the cream would be held at as low a temperature as possible, minus 10° to minus 15° F. or lower. Homogenized cream cannot be used because homogenization destabilizes the protein. According to Dr. Webb, protein instability is also a limiting factor when condensed skim milk is frozen and stored for use in ice cream. Protein instability and insolubility may be reduced to a minimum by preheating good quality skimmilk below 170° F., concentrating 3 to 1, and holding frozen at minus 10° F. or below. P. E. LeFevre discussed frozen cottage cheese, made during the flush season

and used in times of shortage, especially by bakeries. The curd, creamed or dry, is frozen in lacquered cans and held at minus 20° F. Both creamed and dry curd keep equally well, but the freezing does change the character of the curd resulting in a grainier texture and smaller particle.

The program for the second day centered about problems of production and processing of market milk. In a talk on homogenized milk and other developments in the market milk industry, Professor C. A. Iverson, Dairy Industry Department, Iowa State College, stated that homogenized milk is rapidly increasing in popularity, popularity justly deserved by this product. He discussed research findings pertaining to this product of the market milk industry. Dry milk is also a valuable means of getting milk to the consumer when the liquid product is not readily available. This speaker was of the opinion that we are coming to a single standard of quality for milk, no matter what the usage is to be.

Dr. D. H. Jacobsen, Cherry-Burrell Corp., Chicago, stated that by using the polyphosphates and wetting agents, water with considerable hardness may be conditioned for use in can and bottle washers, even with lower concentration of the detergent. However, clean machines, uniformly fed, are necessary to achieve uniformly good cleaning. Dr. Jacobsen recommended several practical uses for quaternary compounds: washing of udders and teats, rinsing farm equipment, rinsing storage and truck tanks, and general plant sanitation. Its chief advantages for these uses are that it is more stable, less irritating to skin, and less corrosive to dairy metals.

A practical standard for clean cans was recommended by V. Schwarzkopf, Lathrop-Paulson Co., Chicago. Cans must look clean, feel clean, smell clean, must look and feel dry, and must be hot as they come from the washer. In his opinion, most can washers could do a better job of washing. The improvement can be effected by daily examination, cleaning, and lubrication of the machine, by selecting the correct washing compound, either alkaline or acid; by using the correct water temperatures and steam pressures for that cleaning compound and by maintaining the wash solution at the correct strength.

C. B. A. Bryant, Johnson and Johnson, discussed the use of the milk filter disc for sediment control. He emphasized the purpose of the filter disc is not to remove sediment, but to serve

Group in Attendance During the Second Day of the Third Annual
DAIRY TECHNOLOGY CONFERENCE
at University of Maryland—December 2–4, 1947

as a measure of the quality of workmanship in milk production.

Farm inspection problems were discussed by R. F. Gaddis, Baltimore City Health Department, and C. S. Brinsfield, Maryland Health Department. The former speaker recommended consistent interpretation of the existing regulations, the premise being to get the best conditions for clean milk production even though at the present time physical facilities for milk production are not entirely satisfactory.

Other speakers at this three-day conference were Dr. J. R. Hilton, North Carolina State College; C. B. A. Bryant, Johnson & Johnson; Dr. L. A. Moore, U. S. Department of Agriculture; C. D. Caskey, Southern States Cooperative; Prof. E. C. Schneidenhelm, Rutgers University; Dr. G. M. Cairns, University of Maryland; D. W. Taylor, U. S. Public Health Service; Dr. C. W. England, P. B. Larsen, R. N. Doetsch, and F. E. Potter of the University of Maryland; G. D. D'Ambrogi, Baltimore Health Department; and V. M. Rabuffo, Ice Cream Trade Journal.

H. S. Adams New Hotel Inspector

Harold S. Adams, formerly chief of the Bureau of Environmental Hygiene, Minneapolis Department of Health, has been appointed director of the Division of Hotel and Resort Inspection, one of the divisions of the Section of Environmental Sanitation in the Minnesota Department of Health. In addition to his new work, Mr. Adams will continue to serve as lecturer in the School of Public Health of the University of Minnesota. Plans are now being made for a closer correlation of activities among the several divisions of the Section of Environmental Sanitation.

Since completing his undergraduate training at Massachusetts State College, followed by graduate work at Massachusetts Institute of Technology and the University of Michigan, Mr. Adams has spent his entire professional career in public health work. During the war he was commissioned as captain and as major in the U. S. Public Health Service. For a portion of his time with that organization he was assigned to the Minnesota Department of Health. He recently published a book entitled Milk and Food Sanitation Practice, which was sponsored by the Commonwealth Fund and reviewed in this *Journal*, September-October issue, page 303).

Krog Leaves Health Post

Andrew J. Krog resigned as public health officer of Plainfield, N. J., on October 1, to become the director of public relations of the Lily-Tulip Company, drinking cup manufacturers. Joining the health department in 1927 as sanitary inspector, he rose to be the health officer in 1933. During his incumbency, Plainfield twice secured the Chamber of Commerce national award for cities of 20,000 to 50,000. After a city wins the award twice, it is no longer eligible in the competition.

Mr. Krog has long been active, especially in environmental hygiene, in the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, the American Public Health Association, the Central Atlantic States Association of Dairy and Food Officials, and the New Jersey Health Officers Association. He has contributed many papers and has served these associations in numerous official capacities. His work with the International Association has been particularly helpful in the field of ice cream work.

New Members

ACTIVE

Titus, R. W., Nestles Milk Products, Inc., Marysville, Ohio

ASSOCIATE

Ackerman, F. W., 1126 River Drive, Watertown, Wis.

Albert, Lorenz A., Milwaukee Bd. of Health, 2944-N. 69th St., Milwaukee 10, Wis.

Allquist, E. John, Land O'Lakes, 621 Carl St., St. Paul, Minn.

Amberg, H. Mike, Rochester Dairy, 900 W. Elm, Waseca, Minn.

Anderson, A. Carl, Land O'Lakes, Roseau, Minn.

Anderson, Archie D., Maple Island Farm Inc., Marine-on-St. Crois, Minn.

Anderson, L. Chester, Northfield Milk Prod. Co., 410 E. 4th, Northfield, Minn.

Anderson, L. P., Land O'Lakes, 235 Houston Ave., Crookston, Minn.

Andrist, U. Walter, State of Minn. St. Paul, Dept. Agr., Dairy & Food, 501 4th Ave., N. E., Brainerd, Minn.

Armshaw, W. J., Monarch Soap & Chemical, 3750 N. E. 5th St., Mpls., 13, Minn.

Atchison, James Wm., Twin City Milk Prod. Assn., Anoka, Minn.

Ball, W. Chester, Twin City Milk Prod. Assn., 802 Curfew, St. Paul 4, Minn.

Barfknecht, W. Curtiss, Tri-County Co-op. Dairy, Winthrop, Minn.

Barnett, H. J., City of Mpls., 4824 Washburn Ave., S. Mpls. 10, Minn.

Bergeson, Reno, Village of Lake Park, Lake Park, Minn.

Bergquist, E. Carl, State of Minn. St. Paul Dept. Agr., Dairy & Food, 5516 Columbus Ave. S., Mpls., Minn.

Bernhardt, Robert F., Bridgeman-Russell Co., Wausau, Wis.

Bjornson, S. Alvin, St. Clair, Minn.

Bliss, J. Ted, Maple Island Farm Im., Box 101 Pine City, Minn.

Bohlig, Chas., Minn. Dept. of Agr., 730 13 Ave. S., St. Cloud, Minn.

Bork, Grant, Neenah Milk Products Co., Almond, Wis.

Brinkman, A. J., Dept. of Health, City Hall, 108 14th Ave. N., St. Cloud, Minn.

Brinkman, J. A., Steel and Tube Prod. Co., 4300 N. Pt. Washington Rd., Milwaukee 1, Wis.

Burish, C. E., Wis. State Dept. of Agr., Edgar, Wis.

Campbell, N. John, City of Fairmount, 923 E. Blue Earth, Fairmount, Minn.

Casey, F. Chas., Rochester Dairy Co-op., Waseca, Minn.

Chab, W. Millard, Red River Valley Farm Serv., Box 154, Crookston, Minn.

Christian, K. D., 910 6th Ave. N., Moorhead, Minn.

Clark, Donald C., Twin City Milk Prod. Assn., 433 E. Main, Anoka, Minn.

Clark, Myron L., Kraft Foods Co., 1810 Ohio St., Oshkosh, Wis.

Combs, B. Willis, Dairy Division, Univ. Farm, St. Paul 1, Minn.

Cornelius, W. E., 5600 W. Roosevelt Rd., Chicago 50, Ill.

Coulter, Todd S., Dairy Division University Farm, St. Paul 1, Minn.

Dahms, John Earl, Northfield Milk, West Concord, Minn.

DeVries, John L., Oakite Prod. Inc., 525 Kingsland Rd., Nutley 10, N. J.

Dobie, W. Frank, 3042 Stevens Ave. S., Mpls. 8, Minn.

Dromgold, C. W., 403 Melrose Ave., Centralia, Ill.

Enge, O. C., City of St. James, St. James, Minn.

Eppard, H. Frank, Rochester Dairy Co-op., 112-9½ Ave. S. C., Rochester, Minn.

Erickson, E. R., Kraft Foods Co., 5111 Luverne Ave., Mpls., Minn.

Falling, S. George, 469 W. First St., Winona, Minn.

Fellenz, J. C., Am. Dry Milk Institute, New London, Wisconsin

Flanery, F. Wm., St. Charles, Minn.

Galitz, H., Klenzade Prod., Inc., 724 Hobart Pl., Beloit, Wis.

Gatzke, Herbert, Kraft Foods, Glencoe, Minn.

Gorges, Clarence, Neenah Milk Products Co., Wittenberg, Wis.

Granius, Frank E., Kraft Foods Co., Wittenberg, Wis.

Gunderson, T., Pigeon Falls Co-op. Cry., Osseo, Wis.

Hahn, Ernest, Kraft Foods, 743 Grove St., Hutchinson, Minn.

Handy, J. J., 3309 43 Ave. S., Mpls, Minn.

Hanson, L. Raymond, Rochester Dairy Co-op., 28 13th Ave. N. E., Rochester, Minn.

Hanson, Peter, Health Dept., 215 Occidental Blvd., Duluth, Minn.

Hanson, Vernon, Rochester Dairy Co-op., Zumbrota, Minn.

Hanson, W. G., North Star Cry. Co., Kenyon, Minn.
Heitke, S. Clifford, No. American Cry. Inc., Paynesville, Minn.
Hilliard, E. Milton, Rochester Dairy Co-op., 610 W. Belleview, Winona, Minn.
Holcombe, Chas., Land O'Lakes, 2201 N. E. Kennedy, Mpls., Minn.
Hortsch, P. J., 214 15th Ave. S., St. Cloud, Minn.
Jachim, J. Raymond, Jordan Co-op. Cry., Jordan, Minn.
Jennings, G. C., Veterinarian Dairy Insp. Morris, Minn.
Jensen, E. H., North Star Creamery, Main St., Kenyon, Minn.
Jensen, K. V., City Dairy Insp., Montevideo, Minn.
Jezeski, J. J., Dairy Div. Univ. Farm, St. Paul 1, Minn.
Johnson, Bud, Bud Johnson & Co., 334 North First St., Minneapolis 1, Minn.
Johnson, C. O., Minn. Dept. of Agr., Dairy & Food, State Office Building, St. Paul, Minn.
Johnson, Geo. L., Land O'Lakes, Buffalo, Minn.
Johnson, R. O., Office of Dairy Inspector, Albert Lea, Minn.
Kanten, C. Glen, Cass Clay Cry. Co-op., 216 N. 13 St., Moorhead, Minn.
Kernkamp, A. Geo., St. Chas. Milk Processing Co., 462 Mount St., Owatonna, Minn.
Kestner, Norman J., Schwartz Mfg. Co., 4001 Alcove Ave., Studio City, Cal.
King, Barry, Land O'Lakes, Frazee, Minn.
Kirkeeide, L. C., B. T. Babbitt, Inc., 4065 No. Montreal St., Milwaukee 9, Wis.
Kliewer, J. Henry, Land O'Lakes, 117 Irving St., Alexandria, Minn.
Knickel, E. H., Consolidate Badger Co-op., 1815 W. Spencer St., Appleton, Wis.
Koivisto, W. Ruben, Todd County Dairy Co-op., Box 18, Browersville, Minn.
Kopischke, Harold, Borden Co., Owatonna, Minn.
Kopp, G., Steel & Tube Prod. Co., 4300 N. Pt. Washington Rd., Milwaukee 1, Wis.
Larson, Russel H., Dairyland Co-op. Assoc., R. 1, Beaver Dam, Wis.
Leaf, H. C., Litchfield, Minn.
Leutmer, A. Henry, Kraft Foods, Melrose, Minn.
Lindvig, J. B., Land O'Lakes, Mora, Minn.
Littlefield, J. L., 601 State Office Bldg., Lansing, Mich.
Lonsdale, E. R., Monarch Soap & Chemical, 3750 N. E. 5th St., Mpls., Minn.
Mattson, C. H., Land O'Lakes Cr. Inc., 6729 Pillsbury Ave., Mpls., Minn.
Melgaard, T. A., Treasure Cave, 220 A Central, Faribault, Minn.
Miller, Giles P., Penn. Dept. of Health, R. D. 3, Norristown, Pa.
Mykleby, W. R., Land O'Lakes Cry., 2201 N. E. Kennedy, Mpls., Minn.
Nelson, H. E., Milk and Dairy Insp., Chisholm, Minn.
Ninow, Wm. H., Borden's-Gridley Division, 2515-A N. 5th St., Milwaukee 12, Wis.
Nohner, Fabian, Kraft Foods, Hutchinson, Minn.
Norlander, A. C., Rochester Dairy Co-op., 1220 6th Ave., S. E., Rochester, Minn.
Nupson, N. H., Penn. Salt Mfg. Co., 506 E. 2nd St., Redwood Falls, Minn.
O'Brien, James P., Wyandotte Chem. Corp., Room 1434, 1st Wisconsin Bldg., Milwaukee, Wis.
Oldfield, G. H., Minn. State Dept. of Health, 870 21st Ave., S. E., Mpls., Minn.
Olmstead, Samuel C., Moberly Health Dept., City Hall, Moberly, Mo.
Olson, Carl J., Dairy Division, 1743 Taylor Ave., St. Paul 4, Minn.
Olson, Paul, Waconia Creamery, Waconia, Minn.
Owen, Bernard John, St. Boniface Creamery Ltd., 251 Maryland St., Winnepeg, Manitoba, Canada.
Parsons, T. E., June Dairy Prod Co. Inc., 414 N. E. 4th, Little Falls, Minn.
Pauley, J. Lloyd, Maple Island Farms, Box 196, Lindstrom, Minn.
Peckarsky, M., Gehl's Guernsey Farms, 3326 W. Capitol Dr., Milwaukee 10, Wis.
Pederson, Chester A., Maple Island Farm Inc., Plaza Hotel, North Branch, Minn.
Peloguin, C. R., Twin City Milk Prod., Elk River, Minn.
Pence, John T., 461 Foster Ave., State College, Penn.
Pesek, M. C., Minn. Agr. Dairy & Food Dept., 605 Locken, Crookston, Minn.
Petersen, Joseph H., Eau Claire City-County Health Dept., Eau Claire, Wis.
Peterson, James C., Maple Island Farms, Inc., Rush City, Minn.
Prell, William J., Land O'Lakes Cry. Inc., Mora, Minn.
Pumper, F. Alois, Northfield Milk Prod. Co., Lonsdale, Minn.
Ramberg, W. John, Maple Island Farms Inc., 210 N. Greeley St., Stillwater, Minn.
Ratzlaff, Alfred, Marigold Dairies, 406½ N. Broadway, Rochester, Minn.
Reiss, A. J., St. Croix Valley Co-op Dairies, Glenwood City, Wis.
Remaly, Robert J., Kraft Foods, 1215 E. 52nd St., Chicago, Ill.
Rentz, Art, Dept. Agr. Dairy & Food, Mora, Minn.
Roberts, L. W., Land O'Lakes, Frazee, Minn.
Rogosheske, A., Kraft Foods, Sauk Rapids, Minn.
Ruhland, M. H., Steel & Tube Products Co., 4300 N. Pt. Washington Rd., Milwaukee 1, Wis.

Sangsland, A. E., Chippewa County Co-op. Dairy, 1021½ Barland St., Eau Claire, Wis.
Schmidt, Ray, Sunset Point, (Dairyland Co-op. Assoc.) Beaver Dam, Wis.
Schmitt, F. O., City Dairy Inc., 2007 Washington St., Two Rivers, Wis.
Schultz, H. H., Steel & Tube Products Co., 4300 N. Pt. Washington Rd., Milwaukee 1, Wis.
Schwarzkopf, V., 2459 W. 48th St., Chicago 32, Ill.
Seal, G. G., Alexandria, Minn.
Sjowall, L. A., Maple Island Farms, Inc., 219 N. Main, Stillwater, Minn.
Skarstad, J. C., Rochester Dairy Co-op., 515 Wilsie St., Winona, Minn.
Sorenson, M. C., Nat'l Butter Co., 739 Pillsbury, St. Paul 4, Minn.
Sorenson, M. K., Dept. Agr., Dairy & Food, 238½ W. Main, Box 123, Marshall, Minn.
Sotaaen, A. C., 317 9th St., Windom, Minn.
Sperry, Lloyd, 901 American Ave., Bemidji, Minn.
Staplekamp, W. R., Tri-County Dairy Co-op., Winthrop, Minn.
Steckelberg, Frederick G., Univ. of Wisconsin, Lodi, Wis.
Steele, H. G., Minn. Dept. of Agr., Dairy and Food, State Office Building, St. Paul, Minn.
Stoelting, C. R., Steel and Tube Products Co., 4300 N. Pt. Washington Rd., Milwaukee 1, Wis.
Strandberg, H., Glenwood, Minn.
Stressmann, E. L., Tri-County Dairy Co-op., Winthrop, Minn.
Sundeen, C. E., Steel and Tube Prod. Co., 4300 N. Pt. Washington Rd., Milwaukee 1, Wis.
Taylor, L V., Maple Island Farms, North Branch. Minn.
Thomas, E. L., Dairy Div., University Farm, St. Paul 1, Minn.
Thomson, E. P., Minn. State Dept. of Agr., 411 W. 6th St., St. Paul, Minn.
Townsend, C. V., Land O'Lakes, 306 Willow St., Faribault, Minn.
Treichler, C. A., Kraft Foods, 505 Hasson St. S., Hutchinson, Minn.
Tryggeseth, A. Oliver, June Dairy Prod. Co. Inc., 4239-31st Ave. So. Mpls., Minn.
Twite, D. Ole, Stewart Co-op. Cry. Assn., Stewart, Minn.
Von Haden, G., Preston Co-op. Cry., Box 184, Blair, Wis.
Wehmer, Robert B., P. O. Box 22, Sparta, Ill.
Weise, Al, Kraft Foods, Glencoe, Minn.
Weishaar, E. E., Wis. State Dept. of Agr., Box 112, Clintonville, Wis.
Welk, Paul H., Columbus Milk Prod. Co-op., 411 W. School St., Columbus, Wis.
Wilson, George W., 4250 Vincent Ave. N., Minneapolis 12, Minn.
Wyman, Henry, Minn. State Dept. of Agr., 116 N. Vine St., Fergus Falls, Minn.
Zakariasen, M. Ben, Land O'Lakes, 2201 Kennedy St., Mpls., Minn.
Zerahn, W. A., Box 441, Ely, Minn.

THIRTY-FIFTH ANNUAL MEETING
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October 21 - 23, 1948